Adjusting First-Term Contract Lengths in the Navy: Implications and Recommendations

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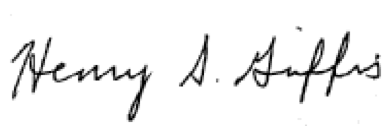

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Executive summary

The existence of an explicit employment contract sets the services and the Department of Defense apart from many civilian employers. Because of this contract, the services are willing to offer and pay for fairly extensive training for their newest employees (first-term enlisted servicemembers). Although exceptions exist, ratings with longer contracts usually offer more training. Thus, servicemembers may be thought of as trading flexibility for training.

While four-year contracts remain common, the Navy has moved increasingly toward longer (five- or six-year) contracts over the past 20 years. During the years leading up to the most recent recession, the Navy also offered bonuses to many sailors in exchange for increasing what would have been a four- or five-year contract by an additional year (an "initial extension"). At the same time, the length and frequency of sea tours has increased among first-term personnel. Sailors with four-year initial contracts usually see the contract expire (they reach the end of their initial obligation) before the end of the first sea tour. This causes substantial turnover in the midst of tours. Partly for this reason, the Navy is considering options for changing the length of the initial contract. Indeed, the "T+X" pilot program, currently in place, changed the length of the first tour in several ratings, bringing about alignment of the end of obligation and the end of the first sea tour. In a companion document [1], we present some preliminary analysis of this program, focusing on a small number of ratings.

In this research, we focus on a larger sample, including data on all new sailors over the last decade. We examine several aspects of contract length changes, looking first at the correlation between contract length and accession. In the last decade, changes in the "menu" of contracts available show virtually no independent relationship with the probability that an applicant will enter the Navy after adjusting for other variables. Other factors (e.g., educational credentials, Armed Forces Qualifying Test scores, and gender) are strongly related to the probability of accession, but applicants access at virtually the same rate regardless of the proportion of five- or six-year contracts available at the time. This is true whether we examine contract length based on rating requirements only or based on rating requirements *and* available bonuses for initial extensions. This suggests that, at least within the range included in our data, contract length availability does not affect the overall probability of accession, holding other factors constant. That is, the value of the training offered by the Navy, as well as enlistment incentives, have thus far successfully compensated new sailors for longer enlistments.

We do not explicitly model the detailing process in this research; the data to do so do not exist. Partly for this reason, we recommend that the Navy invest in a pilot program before making large-scale changes to the contract length menu. We discuss the parameters for such a program in a companion document [1].

But we do examine the relationship between bonuses and contract length in detail. Our results suggest that the Navy can use bonuses to induce sailors to extend their initial contracts in a manner that is likely to be very cost-effective. Our estimate of the cost varies depending on methodology, but all of our estimates fall in a range that suggests that such bonuses are less expensive than most other methods of increasing obligation/man-years.

While poor civilian economic conditions have led to substantial increases in applications and recruit quality since the last recession began, the drastic reduction of enlistment bonuses has actually led to fewer obligated years of service among many ratings and, thus, potentially more misalignment between prescribed sea tours and contract lengths.

The use of bonuses does result in skill channeling; indeed, in the past, this has been the primary goal of such bonuses. If the Navy uses a bonus structure to align obligation with sea tour and/or to increase manning, accounting for the likely effects on quality will be necessary. Currently, overall quality of applicants and accessions is extremely high in historic terms, but, if recruiting conditions degrade, this could be an important aspect of planning for a bonus structure.

Finally, we find little or no evidence that sailors who extend their obligations via bonuses perform in a manner that is different from other first-term sailors. We examine only a limited measure of performance—first-term attrition—but the differences in terms of attrition are very small.

Our results in terms of applicants, skill channeling, and attrition all suggest that the effects of contract length on Navy enlistment/first-term performance are likely to be very small, particularly when all factors are considered. Therefore, focusing on contract length alignment with sea tour to increase Navy efficiency has the potential to pay large dividends. We propose doing so by introducing voluntary incentivized options for the sailors to extend their obligations. By moving away from standardized obligation length, the Navy could take advantage of the flexibility of its recruit market at relatively small costs and with very few risks of disrupting its recruiting and retention processes.

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Introduction

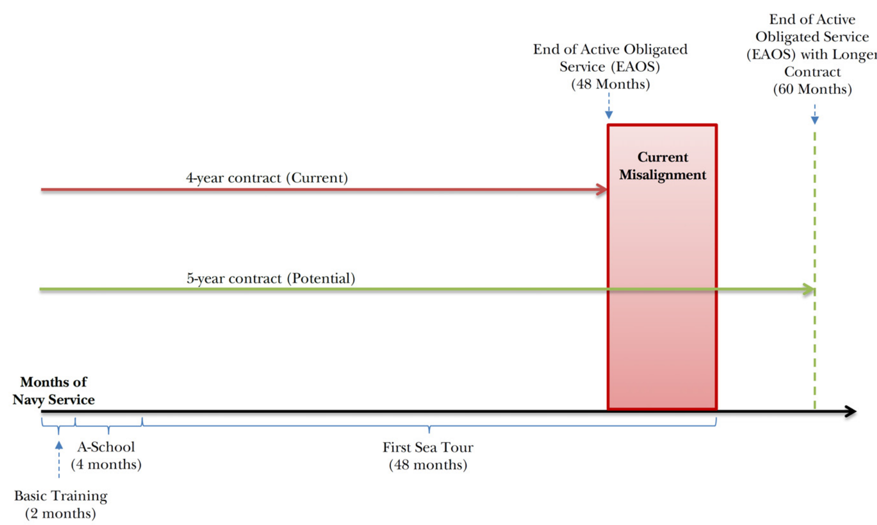
The Department of Defense (DOD) enlists over 150,000 young people into the services each year. It is the largest employer in the world, engaging over 2 million active and reserve servicemen and servicewomen as well as the civilians who support them. For an enlisted active duty servicemember, a key difference between employment with a civilian employer and with DOD is that DOD requires an explicit contract, which obligates the servicemember to spend at least a decreed number of years in the service. The length of the initial enlistment contract varies, but most new sailors over the past decade have entered the Navy with four-, five-, or six-year enlistment contracts.

The enlistment contract allows the Navy to offer extensive training to new sailors, with the assurance that they will remain in the Navy long enough to provide some return on this training investment. This suggests that ratings (jobs) requiring more training will require longer contracts. Indeed, there is a relationship between the length of the training pipeline and the length of the contract, but there is significant variation in training pipelines among those who sign, for example, four-year contracts [2]. Also, there is little evidence that contract lengths change as training pipelines change. Thus, the optimal contract length is likely to be determined by training costs *and* other factors.

Of course, there are other factors aside from return on training investment that are likely to affect the optimal contract length. For example, most sailors spend a large proportion of their first enlistment terms in sea billets. Specifically, enlistment into each rating comes with a first prescribed sea tour (PST), on which the sailor usually embarks shortly after completing initial training. Of the sailors who started their sea tours in FY12, however, 83 percent are scheduled to come to the end of the initial obligation before reaching the end of the initial sea tour (see figure 1). This can create problems in sea/shore flow and in keeping sea billets manned. It also is costly to the Navy because those sailors who choose to leave the Navy at the end of the initial obligation have to be replaced at sea. Their decision to leave can be made late enough in the process to disrupt sea/shore rotation and manning.

A recent CNA study [3] found that losses due to the End of Active Obligated Service (EAOS) account for as much as 39 to 57 percent of sea tour incompletions, depending on the length of PST and time period of analysis. The T+X pilot program seeks to align sailors' obligations and the ends of their sea tours by extending obligation to reflect the length of the training pipeline (T) and the initial PST (X) for several ratings. Figure 1 represents the potential for T+X to increase alignment and extend obligation to or beyond the end of the PST. The details of the program are discussed in a companion document [1].

Figure 1. Contract length and sea tour alignment



Other factors that are likely to figure into optimal contract length include optimizing the total months of service received from an initial contract and staffing billets with specific paygrade/experience requirements. Finally, the optimal contract length depends on the supply of potential sailors; for example, using reenlistment bonuses versus enlistment bonuses may be a preferable way to extend service under certain circumstances. Indeed, it is likely that there is no single optimal contract length. Rather, the optimal contract length is likely to vary depending on the skill/knowledge requirements of the specific rating, the civilian economic conditions at the time the sailor enlists, and other factors.

During the last decade, the Navy has seen dramatic changes in end-strength and the number of enlistees, the quality of those enlistees, the training provided, the sea-shore flow, and civilian opportunities. This large degree of variability allows for an analysis of enlistment bonuses, despite the inability to explicitly model the detailing process because data to do so do not exist.

In this research, we analyze enlistment contract policies. Specifically, we use data from several sources to model the choice that potential sailors make as a function of available contracts. In the second stage of this research, we model several outcomes—in particular, attrition—as a function of the contracts available at enlistment. Finally, we compare responses during different economic conditions to test the hypothesis that potential sailors' willingness to sign longer contracts is affected by their other options in the civilian economy.

We begin with a discussion of what the relevant literature—civilian and military—has found about the effects of contracts on employment outcomes.

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Background

We begin our literature review with an overview of relevant civilian analyses that are especially pertinent to employment contracts and the experiences of military enlistees. These findings provide explanations for the Navy's insistence on employment contracts and for sailors' hesitations to sign long contracts. From there, we move to the military-specific contract literature, which provides estimated costs of increasing contracts. Other work also provides insights into the likely effects of longer contracts on months of service and on attrition rates.

Civilian literature

In the absence of outside factors, we expect employees to get paid what they are worth to firms, sometimes referred to as their marginal product [4, 5]. This theoretical finding does not hold at all points in time, however, for many reasons. From our perspective, the most important factor is the training provided by the Navy. Economists consider two categories of training: "general" training makes employees more valuable to all firms, whereas "firm-specific" training makes employees more valuable only to the firm providing the training [4, 6]. Learning widely accepted accounting principles is an example of general training; learning a firm's specific system for submitting paperwork is an example of firm-specific training.

Both economic theory and empirical findings suggest that employers are unwilling to pay for general training because it is readily transferable to a different job/employer. The existence of an employment contract, which obligates the employee to remain with the employer after the completion of training, is a key reason why firms might be willing to pay for general training [4, 6, 7].[1] Indeed, when people in

1. Another way a firm may avoid paying for general training is to pay a low wage *during* training; but, if training is relatively expensive, it may not be possible to pay a wage low enough to make up for the training costs.

the Navy suggest that "return on investment" motivates contract lengths, this is exactly what they're talking about.

Firms should be willing to pay at least part of the cost of firm-specific training because the skills imparted are not portable. The Navy, however, like any other employer, would not be willing to pay the entire cost of firm-specific training without an employment contract. Although the training is not portable, employees who have completed it can demand a higher wage.

The Navy provides both types of training at the beginning of sailors' careers. It advertises general training as part of the compensation package: "you'll find unrivaled training and unequaled experience in a career of your dreams" [8]. During bootcamp and the training that follows, the Navy not only pays the cost of training but also provides wages and benefits to sailors while receiving little in return. Once training ends, however, the Navy will recover these costs by filling jobs with sailors whose training prepares them specifically for these jobs.

The ability for the sailor to receive valuable training coupled with the Navy's ability to receive a return on its training implies that very long contracts could be optimal for both the sailor and the Navy, but there are reasons why each might hesitate to sign extremely lengthy contracts. From the Navy's perspective, it may not have perfect information about its future needs. Both the ability to naturally reduce the force (via expiring contracts) during a drawdown and the ability to cull underperformers serve to temper the Navy's desire for longer contracts. From the sailor's perspective, longer contracts are likely to be viewed as increasingly undesirable. Research has shown that risk-loving people are less likely than others to hold fixed-wage contracts in the private sector [9]. So, to the extent that the Navy tends to attract risk-loving people, the cost of convincing recruits to accept the fixed-wage contract is likely to rise as contract length increases.[2]

2. Indeed, by offering to pay for training, the Navy is offering a compensation scheme most likely to appeal to risk-averse people (or possibly those with credit constraints) coupled with work that should appeal to risk-loving people. To the extent that risk varies by Navy rating, optimal contract length may vary in a manner not associated with any of the other factors discussed here.

Further, if the labor market returns to military service are lower than the returns to working in the private sector or other parts of the public sector, this may also decrease sailors' willingness to sign longer contracts. Several studies have estimated that veterans experience an initial negative wage gap upon entering the private sector with an eventual convergence (see [10] for an overview of the literature).[3]

Finally. shorter contracts allow sailors to acquire more frequent offers from the private sector; for example, a sailor who wishes to stay in the Navy for 6 years is still likely to prefer a three-year to a six-year contract; at the end of the first three years, the sailor can consider private-sector offers and either choose to reenlist or accept at no penalty a civilian offer that "he can't refuse."[4]

Contracts in the military

There are (at least) three key components of a Navy contract: the Navy rating promised, the contract length, and the signing bonus.[5] The three variables are not independent; both signing bonuses and contract length are often directly dependent on the Navy rating or job. Especially in the Navy, enlistment bonuses (EBs) are used more

3. This stylized fact is a source of contention in the literature; some studies suggest that the wage differences are purely cohort effects. Indeed, this will affect sailors' decisions only to the extent that they believe that military service will negatively affect future wages; given the services' emphasis on training and sailors' likely discount rates, effects of this phenomenon are likely to be small.

4. This example assumes that the sailor can reenlist at will. In the current environment with Perform To Serve, this is likely to be a less reasonable assumption than in the past; also, the likelihood of civilian offers will depend on civilian economic conditions. Despite these factors, the general premise holds, but the sailor may be willing to sign a longer contract for less additional pay owing to a combination of civilian factors and Perform To Serve.

5. Previous research suggests that, while using basic pay to affect a sailors' enlistment/reenlistment decision is theoretically feasible, it is impractical—both because the Navy does not set basic pay levels directly and because basic pay increases happen across the board, yielding a very costly policy lever [2, 11].

as a skill-channeling tool than a market expansion tool [12, 13, 14]. EBs also have been used to induce recruits to accept longer contracts [12, 15]. Finally, there may be an interaction between job availability and contract length; because recruits value job choice, they may be willing to accept additional contract length for a "better" job [16]. Each of these aspects will also be related to outside factors; the struggling civilian economy has led to near elimination of the EB and longer contracts for some ratings as the Navy faces a queue of people who desire to enlist in these ratings.

While most research in the area of contract length and enlistment is empirical in nature, one theoretical piece found that the returns from optimizing contract lengths were likely to be modest [17]. This research, however, explicitly assumes that military members have perfect foresight in knowing exactly how long they intend to serve and that civilian wages grow at a constant rate. Both of these assumptions remove substantial portions of uncertainty from the decision process, making longer contracts both less valuable to the Navy and more palatable to the recruit. Use of more plausible assumptions may affect the estimated returns to contract length optimization substantially.

Reference [15] describes the results of an experiment in the late 1990s, in which the Air Force offered signing bonuses to individuals who were willing to enlist for six years in a select set of jobs. The authors viewed the implementation of this policy as a quasi-natural experiment through which the cost of an extra year of service could be calculated. They find that the Air Force paid between $8,052 and $11,061 per additional man-year. These estimates are likely a lower bound on cost because some of the gains to longer contracts are likely to have come from people who would have signed long contracts in other specialties in the absence of the change in policy. To the extent that the risk-preference composition of the Navy (or a specific Navy rating) is different from those examined in the Air Force, and to the extent that the results were driven by the robust civilian economy, we might expect to find somewhat different results in this work.

However, this increasing cost of contract years was also found in a study of a randomized experiment involving enlistment bonuses in the Army during the mid-1980s [18]. During this time, enlistment lengths ranged primarily from two to four years. Before the experiment, the Army offered a $5,000 EB to select specialties (primarily combat specialties) in an attempt to entice people to accept these hard-to-fill jobs, which had four-year contracts. The experiment was explicitly designed to estimate the effects of offering different bonus and contract length combinations on contract choice. Three schemes were randomly assigned for these specialties: maintaining the status quo (a $5,000 bonus and required four-year commitment), a focus on long contracts (an $8,000 bonus and required four-year commitment), and a combination of intermediate and long contracts (an $8,000 bonus attached to four-year commitments and a $4,000 bonus attached to three-year commitments). The authors here found that both contract schemes lead to significant market expansion in these combat specialties, although they presented evidence that the same market expansion effects could have potentially been achieved at a lower cost through additional advertising or more recruiters. The same caveats from [15] apply.

The main result of relevance from [18] for this study, then, involves the relative behavior of recruits facing the two new incentives. Recruits who faced the long EB option (i.e., who were paid $3,000 more to accept a four-year contract) were 15.3 percent more likely than recruits under the status quo to commit for four years. The probability of enlisting for two and for three years fell. Recruits who were exposed to the intermediate mix sorted primarily into three-year contracts: the rate of three-year enlistments increased by 87.4 percent, at the cost of fewer two-year enlistments (the probability of choosing a four-year contract was unchanged). The movement of the gains from four- to three-year contracts when we move from the long-term to the intermediate-mix options, then, implies that many enrollees prefer to sign on for fewer extra years of service if the signing bonus per extra year of commitment is the same. Here, we see additional support for one of the implications of [15]: the enlistment bonus cost of an additional year of contract length is likely to increase as contract length increases.

Finally, one study used a conjoint survey approach to ask respondents to choose between contracts that had varying characteristics, including bonuses, job choice, and contract length [16]. This survey-based approach is different from most of the other existing literature, which examines the realized behavior of recruits, but the findings have some relevance.[6] First, [16] finds that contract length is less important to people who indicated a high propensity to enlist in the military than to those who indicated a medium propensity. For the medium propensity group, indifference between a four- and five-year contract required a 60-percent larger per-year (100 percent larger in total) enlistment bonus in the five-year contract. Indifference between a four- and six-year contract required a 170-percent-larger-per-year (300 percent larger in total) enlistment bonus in the six-year contract. This seems to suggest that increasing contract length by one year will become more costly as contract length increases (four to five years required an EB increase of $5,000, whereas five to six years required an increase of $10,000).

To summarize, the existing literature suggests that sailors can be induced to accept longer contracts. The cost of doing so, however, may vary based on the ratings involved and on the current economic conditions. In addition, lengthening contracts is likely to become quite expensive at some point; the literature suggests that additional years are increasingly costly. The Navy's willingness to support longer contracts will depend on both of these factors, as well as on the amount of useful labor that extended contracts produce. First, mismatches between contract length and job-specific sea tour length suggest that longer PST lengths lead to significantly less than a one-for-one increase in average actual sea tour duty [20]. Further, one of the major causes of incomplete sea tours among first-term sailors is reaching the end of obligated service [20]. While the T+X pilot explicitly addresses this, the finding also suggests that the optimal contract is likely to depend on a sailor's rating: six extra months of service from a sailor who would have already completed his sea tour may well add less useful service than six extra months of service from a sailor whom the Navy would have otherwise had to replace mid-tour. Second, to

6. It is unclear how to compare survey-based research with research based on recruits' behavior. Surveys lack incentives to encourage respondents to be truthful; for example, sailors have generally understated their reenlistment intentions, perhaps to give weight to expressed concerns [19].

the extent that contract length has a direct effect on attrition, longer contracts may lead to more or less additional service than expected. Longer contracts could affect attrition directly or indirectly, either by causing a change in the sailor's attitude or by requiring larger EBs, which in turn affect attrition.

Most of the current knowledge of the direct effect of contract lengths on attrition is incidental; that is, studies include contract length as a control variable in attrition regressions that are focused on other phenomena. Note that these estimates are unlikely to be causal because both attrition and the decision of contract length may be jointly affected by unobserved outside factors. One such study finds a weak (and not statistically significant) negative correlation between contract length and bootcamp attrition [21]. Similarly, a recent study of the Marine Corps [22] finds a negative correlation between contract length and bootcamp attrition.

There has been some research examining the effect of larger EBs on attrition behavior. The authors of [12], for example, hypothesize that EBs and attrition are negatively related, but they do not find a consistent effect in the data, suggesting that EBs do not decrease attrition in an economically meaningful way. Similarly, [15] estimates a positive but statistically and economically insignificant effect of EBs on attrition behavior in select Air Force specialties. In contrast, a study of Army attrition behavior [14] uses an instrumental variables approach to find that attrition is 1.7 percentage points (5 percent) lower for those who receive an EB than for those who do not. Finally, [13] finds that longer contracts are correlated with lower Delayed Entry Program (DEP) attrition for recruits in the 1990s.

The general consensus in the literature is that increased contract lengths are correlated with, at worst, small increases in attrition and that they may well decrease attrition [21, 22]. This holds even if the longer contracts are paired with higher EBs [14]. Consequently, we expect that any erosion of useful service gains from longer contract lengths will come from other sources (e.g., the aforementioned mismatched contract lengths and PSTs [20]).

Finally, the willingness of the Navy to use longer enlistment contracts will depend on the cost-effectiveness of doing so. Bonuses are likely to be more effective at increasing contract length than basic pay for several reasons. For instance, the Navy does not set basic pay; basic pay increases are done in an across-the-board manner, and members of the military tend to have high discount rates.[7] As shown in [23], even when offered the choice of separation payment in bonus or installment form with an implicit discount rate of 17 percent, the majority of military servicemembers chose the bonus, meaning that the majority have a discount rate higher than this. As such, we would expect that, for a given level of compensation, a sailor would prefer having the compensation paid as an up-front bonus (discounted at the Navy's presumably lower discount rate) to having it paid as a monthly payment. Bonuses also serve as a flexible tool for the Navy. Unlike pay increases, EBs can be targeted either to specific ratings or to sailors satisfying a range of criteria (or both). Furthermore, bonuses serve as a tool that can be removed if necessary: the recent suspension of most EBs in response to the civilian-sector downturn illustrates this utility.

References [15] and [18], discussed in more detail earlier, suggest that using longer contracts will likely be a cost-effective means of meeting manpower requirements, especially when compared with using EBs to increase the recruit pool. A significant problem with the existing analyses of the cost of an additional contract year, however, is their focus on a handful of specialties; another problem is that some of the gains likely result from sorting or skill channeling. A key contribution of this paper, then, is the isolation and elimination of this sorting effect in our calculation of the cost of an additional contract year. Once this effect has been removed, we have the cost of inducing applicants who otherwise would have (a) signed shorter contracts or (b) signed no contract to instead sign a long contract. This is, we feel, a more intuitive definition of the cost of an additional contract year.

7. The discount rate measures how much compensation a person demands in the future to give up $1 today; people with high discount rates require more money in the future than people with low discount rates in exchange for $1 today.

Data sources and methodology

Our focus is on determining how a change in the length of the first-term contract will affect sailors and potential sailors. We begin by examining the correlation between the probability of accession and contract length. We then move on to examine the relationship between bonuses and contract length, as well as the skill-channeling effects of bonuses/contract length. Finally, we examine the relationship between contract length and first-term attrition. To examine these different questions, we need data from several different sources.

To form the most complete picture possible of the enlistment process and the first term, we combine data from two sources. We use the Defense Manpower Data Center (DMDC) applicant files to form a dataset of potential sailors who go to a Military Entrance Processing Station (MEPS) with the intent of entering the Navy; we refer to this file as the "applicant file." We include all potential applicants in the FY03–FY10 time period. We use CNA's Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE) files to form a dataset of all who enlisted in the Navy; we refer to this file as the "accession file."[8] In this file, we include accessions in the FY04–FY10 time period.[9] Our outcome measures include entry into the Navy, contract length, and attrition during the first term. As we discuss in more detail in this section, applicants may have the choice to extend the length of their initial contract in exchange for a bonus.

8. We are grateful to Marisa Michaels of DMDC for preparing the applicant files. We discuss details of these datasets, and definitions of variables, in appendix A.

9. Sailors typically enter the Navy some months before they actually ship to bootcamp. To account for this timing, we include applicants from FY03 but begin tracking accessions in FY04.

Our goal is to measure the relationship between various factors and our outcomes of interest. For example, we would like to know how the availability of long contracts correlates with the probability that a given applicant will enter the Navy; we are also interested in how the availability of an enlistment bonus correlates with the probability that an applicant will sign a "long" contract. In each case, we model the probability of the outcome as a function of individual characteristics, contracts available, and relevant economic factors. In these cases, we use a logistic (logit) model.[10]

While the majority of those who intend to enlist do so, a sizable minority of applicants leave the MEPS without entering the Navy. For example, during FY10 about 71,000 young people entered a MEPS with the intention of enlisting; about 34,000 left the MEPS without enlisting/entering DEP. There are several possible reasons for this. In brief, candidates may fail to qualify because of health issues, low test scores, lack of education credentials, or other background issues (such as criminal convictions), they may have a change of heart, or they may choose not to enlist if desired ratings/contracts are not available. These people would appear in the applicant file but not in the accession file. However, the applicant files include an indicator of enlistment, as well as detailed information about each potential sailor's qualifications and the rating promised to sailors who enlist.

Because of the well-established role of bonuses in skill channeling, we also estimate the effects of bonuses on the skill mix within ratings. In this case, our outcome is the proportion of recruits within a specific rating who fall in a quality cell. (For example, one data point might indicate that 62 percent of recruits in rating X in a specific month have Armed Forced Qualifying Test (AFQT) scores of 50 or better and are high school diploma graduates.) These outcomes allow us to determine the relationship between bonuses and skill channeling.

10. Logit models are designed to estimate dichotomous outcomes, or outcomes that have two possible states (enlist in the Navy or do not; attrite before the end of the contract or do not). However, the interpretation of the nonlinear marginal effects is not straightforward. We present marginal effects calculated at the sample mean; except where noted, we present complete results in the appendix.

Because these outcomes are proportions, an ordinary least squares (OLS) model is appropriate.

The classification process, in which a detailer presents possible ratings to a potential sailor at the MEPS, is an important facet of the accession process. Because the time a classifier spends with each recruit is limited, classifiers exercise necessary discretion and present each recruit with a subset of available options. Unfortunately, this subset is not recorded. We thus do not model the detailing/classification process explicitly; the data to do so do not exist. In this research, we treat this process as an unobserved step along the route to enlistment. Our results, then, should not be interpreted as causal, but instead as conditional correlations between the variables of interest.

In the next section, we present some descriptive statistics from these datasets; we present the results in the section after that.

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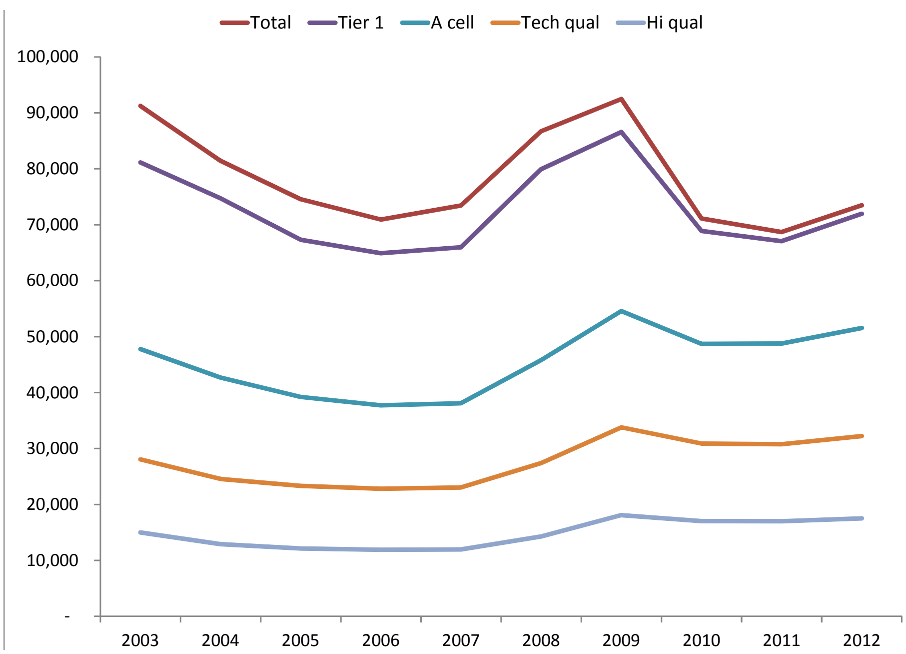
Descriptive statistics

In this section, we describe the numbers and quality measures of applicants and enlistees. We provide details on contract length and how it varied over the period covered by our data. Finally, we provide some information on the characteristics of sailors who sign longer versus shorter initial contracts.

Trends in applicants and accessions

During each year of our sample period, 68,000 to 93,000 potential applicants entered a MEPS with the intent to enlist in the Navy, yet only 33,000 to 39,000 sailors actually entered the Navy (see figure 2). Thus, many applicants or potential applicants do not enlist.

Figure 2. Applicants, by FY and quality measures[a]



a. Data from DMDC applicant files. See bulleted listing on next page for definitions of quality measures (Tier 1, A-cell, technically qualified, and highly qualified).

Figure 2 also indicates the number of applicants who meet a series of quality standards, defined as follows:

- *Tier 1:* Applicant holds a high school diploma or equivalent credential.
- *A-cell:* Applicant holds a high school diploma or equivalent credential *and* has an AFQT score of 50 or higher.
- *Technically qualified:* Applicant holds a high school diploma or equivalent credential *and* has an AFQT score of 67 or higher.
- *Highly qualified:* Applicant holds a high school diploma or equivalent credential *and* has an AFQT score of 80 or higher.

Applicants with higher AFQT scores are eligible for more technical ratings and training. Because contract length is related to training, applicants with higher AFQT scores are more likely to be eligible for ratings that demand or offer longer contracts. Applicants scoring 80 or higher on the AFQT tend to be eligible for most or all technical ratings [24].

Figure 2 shows that the total numbers of applicants and qualified applicants respond sharply to economic conditions. When the civilian economy entered a recessionary period in late 2007, the number of Navy applicants rose sharply.[11] Figure 2 suggests that the number of highly qualified applicants is less responsive to economic conditions, but this is driven by the smaller base. Between 2007 and 2009, the number of applicants increased by about 20,000 (about 25 percent). The number of highly qualified applicants increased by only about 6,000, but this represented a 50-percent increase. (The trend was similar among technically qualified applicants.) Thus, while most of the additional applicants were not highly qualified, by 2009 the Navy had more highly qualified applicants from which to choose.

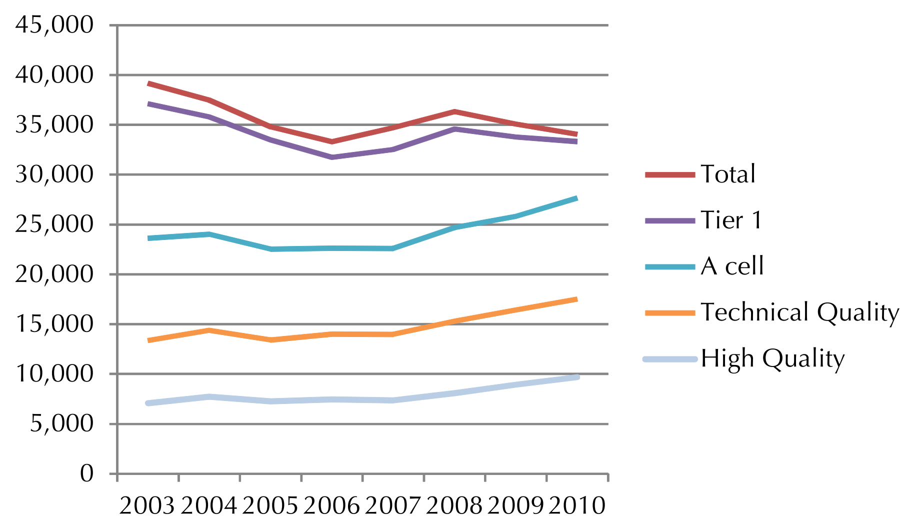
An important step between the MEPS and Navy bootcamp is the Delayed Entry Program; it is typical for sailors to spend at least a few

11. According to the National Bureau of Economic Research, which determines when the U.S. economy enters and exits recessionary periods, the most recent recessionary lasted from December 2007 to June 2009.

weeks in DEP after signing a contract but before shipping to bootcamp. Indeed, some sailors may spend as much as a year in DEP. DEP status is especially common among those who enlist in the Navy before completing high school; these recruits often enlist during their final year of high school, enter the DEP, and then ship to bootcamp during the summer after graduation. Because of this lag between MEPS and bootcamp, it is not appropriate to assume that applicant and accession files from the same years include exactly the same people. Indeed, it would not be uncommon for recruits to appear in an applicant file in one fiscal year, spend some time in DEP, and appear in the Navy (and the accession file) in the following fiscal year. Therefore, descriptive statistics for a given year indicate the number of applicants who entered MEPS during the year and the number of accessions, but these groups do not include exactly the same people.

With this time lag in mind, we now examine the numbers of accessions and very qualified accessions, per fiscal year. Figure 2 showed that the Navy had an opportunity to enlist increasingly qualified sailors in 2007 through 2009. Figure 3 suggests that this is exactly what happened; quality increased markedly in this period. (Note that the scales of the two figures differ so that smaller trends are visible in figure 3.)

Figure 3. Accessions, by FY and quality measures[a]



a. FY03–FY10 NPS accessions in all ratings. See bulleted listing on page 22 for definitions of quality measures (Tier 1, A-cell, technically qualified, and highly qualified).

While the overall number of accessions decreased slightly across this time period, the numbers of A-cell, technically qualified, and highly qualified accessions increased markedly after FY07. Indeed, by FY12, 87 percent of new sailors were A-cells; in FY04 only 65 percent of new sailors qualified as A-cells. The percentage of sailors who were technically or highly qualified also increased over this same period. Taken together, figures 2 and 3 suggest that quality, as measured by education and test scores, of applicants and sailors increased sharply over this period. Therefore, many of the sailors who entered the Navy in recent years may have been qualified for technical ratings and thus for relatively long contracts. Next, we examine contract lengths.

Trends in contract length

Contract lengths do change over time and do differ across the services. In figure 4, we present detailed information about the contract lengths offered and accepted by new sailors from 1990 until today. While short contracts (of less than four years) were quite prevalent in the early 1990s, they have become increasingly rare, and longer (five-year and six-year) contracts have become more common; today, roughly half of all sailors sign an initial contract that obligates them to at least five years in the Navy.[12]

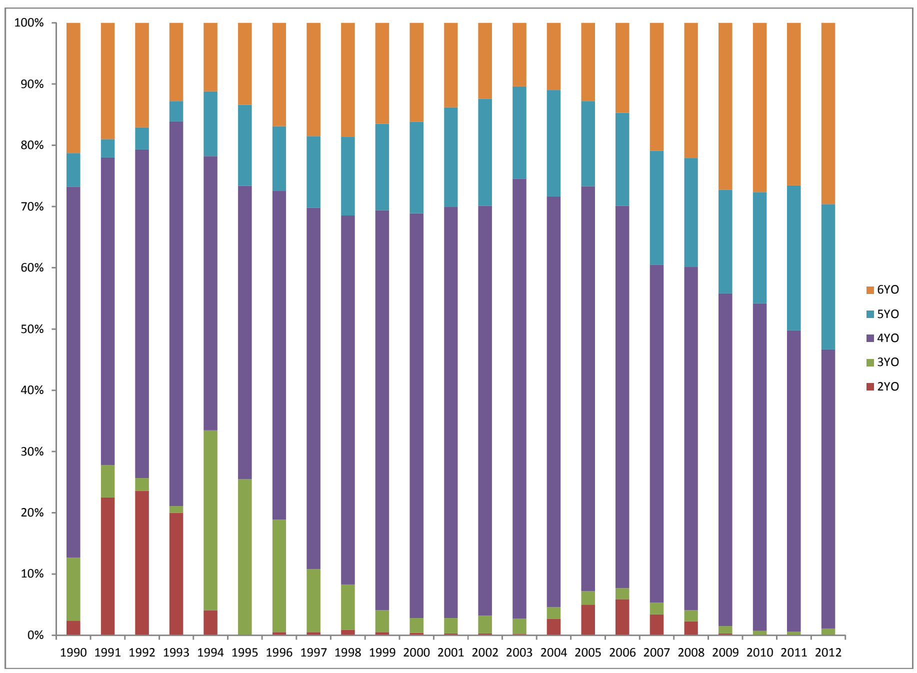
Our data on Navy accessions are very detailed; while we lack equally detailed information from the other services, we do have some information on contract length across the services. There is substantial variation across the services in terms of contract length, as shown in figure 5. In current years, the Navy and the Air Force have moved toward longer contracts. (Although not shown specifically in figure 5, the Air Force has moved largely to six-year contracts.) The Marine Corps also has longer contracts than in the past, but the Army has moved toward shorter, specifically three-year, contracts.

The contract lengths described above, specifically those in figure 4, are determined based on rating; some ratings require four-year

12. The short contracts in the early- to mid-1990s were offered partly to help with planned downsizing.

obligations, while others require five- or six-year obligations. During our sample period, however, substantial numbers of sailors were offered and accepted longer obligations in exchange for initial bonuses. We refer to these as *initial extensions*. (We use this terminology to avoid confusion; typically, a contract extension occurs at the end of a sailor's term).

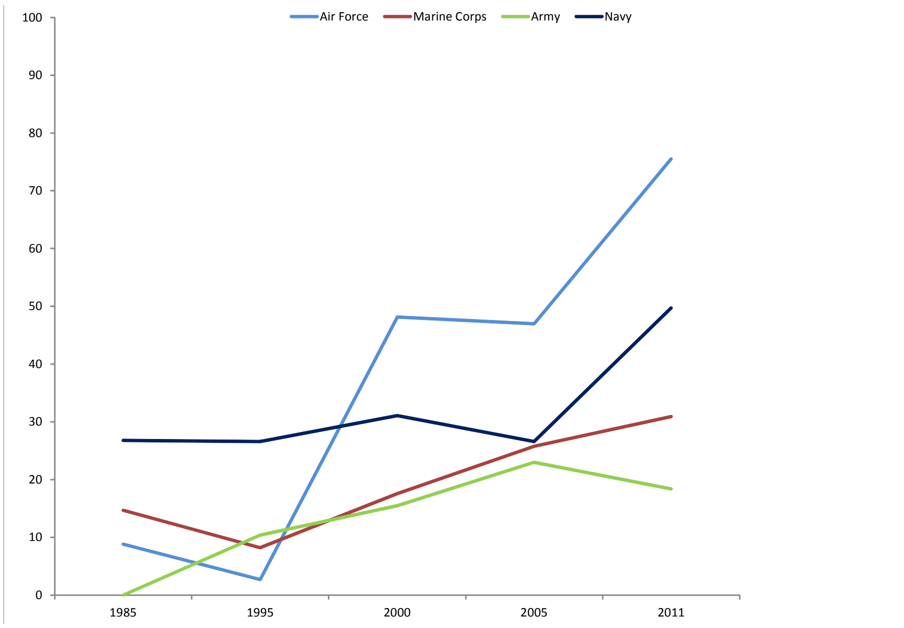
Figure 4. Navy contracts, by length of obligation and fiscal year of accession[a]



a. Source of data: CNA's Street-to-Fleet files. The length of contract is based on rating; if sailors signed an initial extension for a longer contract in exchange for a bonus, that is not reflected here. However, we discuss the use of such bonuses in the text.

Finally, we present the most recent years of Navy data in a more detailed format (figure 5) indicating that both five- and six-year obligations have increased in the Navy, while four-year obligations have decreased in a parallel manner.

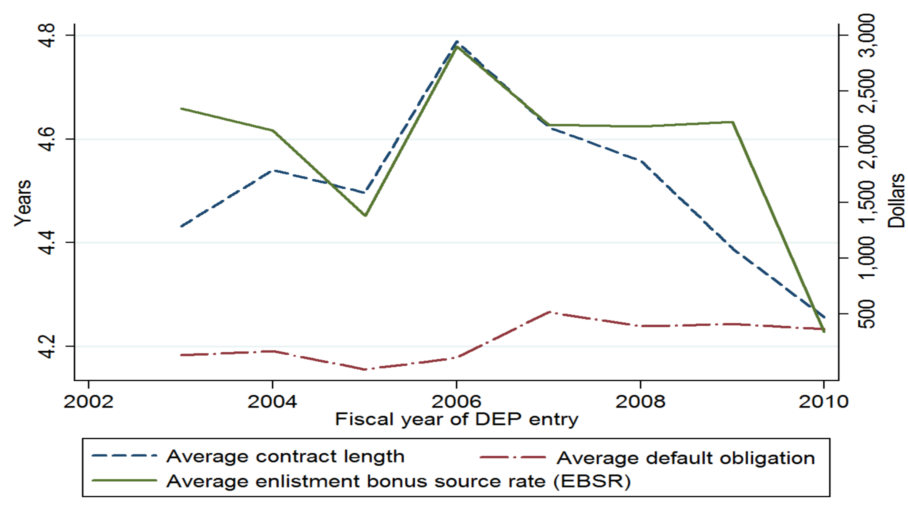
Figure 5. Percentage of new contracts that are for 5+ years of obligation, by service and fiscal year of accession[a]



a. Data provided by Defense Manpower Data Center based on cross-service accession files.

Figure 6 shows the average default obligation (the obligation implied by the rating) and contract length (the obligation including any initial extensions in exchange for a bonus) of Navy accession by fiscal year, as well as the average enlistment bonus. To calculate average enlistment bonus, we take the average across sailors of accepted bonuses that were paired with longer active duty obligations. Because we are concerned with the contract-lengthening aspect (and consistent with our analysis that follows), we omit ratings that have default 6-year obligations (mainly nuclear field and special operations ratings). As figure 6 shows, the average contract length and average enlistment bonus fell concurrently after 2006 for ratings that did not have a 6-year default obligation. The reason for this decline is simple: as the Navy began to offer fewer bonuses, fewer bonuses were accepted, which resulted in fewer bonus-driven contract extensions.

Figure 6. Length of obligation, new sailors, by fiscal year of accession[a]



a. FY03–10 accessions. Ratings for which 6-year obligation are the default are omitted.

Next we present some descriptive statistics designed to explore the differences between those who sign longer and shorter contracts.

Who signs longer contracts in the Navy?

Table 1 compares those who sign four-, five-, and six-year contracts on several attributes. The table also demonstrates that those who sign longer contracts differ on several characteristics; we would expect education credentials and test scores to be higher among sailors with longer contracts, and we see that this is the case. (The contract length reported here is the actual length of the sailor's contract, including any extended time in exchange for bonuses.) In particular, sailors in six-year contracts have a substantially larger portion of applicants that have at least some college than sailors in four- or five-year contracts, perhaps due to the widespread availability of two different bonuses in our sample period. The Enlistment Bonus for College Credit (EBCC) and the Source Rating Enlistment Bonus (EBSR) were used during this period; both require that the sailor sign a contract that is one year longer than would otherwise be required by the rating. Sailors may receive both bonuses; doing so obligates them only to one additional year of service. We see a similar median age across sailors in the three contract lengths. There are also slight differences in race and ethnicity: those in longer contracts are less likely to be black and slightly less likely to be Hispanic. We do not observe a consistent difference in the gender composition of those who hold longer contracts relative to those who have four-year contracts.

Table 1. Sailor characteristics, by contract length[a]

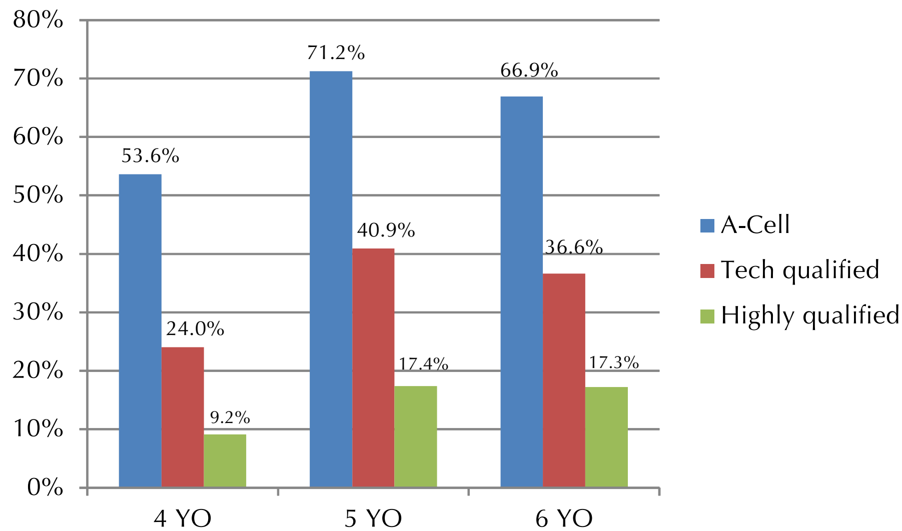
Characteristic	Length of contract		
	4 years	5 years	6 years
Median age	19	19	20
Percent male	78.3	83.3	77.9
High school diploma[b]	84.4	81.6	57.4
Some college[c]	4.1	6.8	27.8
Bachelor's degree[d]	1.5	2.4	6.7
AFQT: < 50	41.0	23.4	29.5
AFQT: 50–64	30.8	30.2	30.0
AFQT: 65–92	26.3	42.5	35.6
AFQT: 93 +	1.9	4.0	4.8
Percent African American	24.9	18.1	18.9
Percent Hispanic	20.8	19.1	18.5

a. Sailors listed include NPS accessions with programs requiring less than a 6-year obligation by default.
b. Or equivalent (includes those with some college, adult education credentials, and other credentials considered equivalent to a high school diploma; excludes those who dropped out of high school or earned a GED).
c. Includes traditional high school diploma graduates who also earned some college credit before enlistment and Associate degree.
d. Includes individuals with higher degrees.

Figure 7 takes the analysis one step further, demonstrating that sailors with longer contracts are indeed of "higher quality" by a number of measures. Based on figure 7, those who sign six-year contracts are likely to be qualified for even the most technical ratings.

While the services do seem to offer longer contracts in ratings with more extensive training, they also may tend to increase contract lengths when civilian jobs are scarce. Figure 8 demonstrates that the Navy's recent increase in longer contracts coincides with an increase

Figure 7. Recruit quality in different contract lengths[a]



a. Includes NPS accessions with programs requiring less than a 6-year obligation by default (no nukes or special forces). *A-cell:* High school diploma or equivalent credential **and** AFQT score of 50 or more. *Technically qualified:* High school diploma or equivalent credential **and** AFQT score of 67 or higher. *Highly qualified:* High school diploma or equivalent credential **and** AFQT score of 80 or higher.

Figure 8. Contract length and civilian unemployment rate, by FY

in the civilian unemployment rate. This suggests that the optimal contract length for a given rating may differ with the civilian economy; this also suggests that the Navy already adjusts contract length based on economic conditions.[13] What is not clear from either the literature or figure 8 is the extent to which a shift into a longer contract means that the rating attracts sailors with different characteristics, such as a lower (or higher) tendency toward attrition.

Our descriptive statistics suggest that those who sign longer contracts are of higher quality by many measures. In particular, sailors who sign longer contracts are more likely to have a traditional high school diploma or some college; completing high school and attending college are both associated with lower attrition (e.g., see [24] or [25]). Also, sailors who sign longer contracts tend to have high scores on the AFQT and the Armed Services Vocational Aptitude Battery (ASVAB); high test scores are predictive of completing training successfully (e.g., see [26]). However, it is not clear that the long contracts, per se, affect a sailors' probability of attrition. While it is possible that sailors who consider attrition are influenced by the term of the contract, there is no empirical evidence of this and the fact that sailors who sign longer contracts are older, more educated, and have higher test scores than other sailors suggests that, instead, longer contracts serve to "steer" sailors who are most likely to complete training into specific ratings. This is consistent with much of the literature, which suggests that at least in the Navy, contract length differences are actualized by bonuses and work through skill channeling. Also, the Navy does change contract length in a specific fashion. As the civilian unemployment rate increased in 2007 and 2008, the number of applicants and the number of highly qualified applicants increased. At the same time, the Navy increased contract length, often through bonuses designed to induce applicants to extend their contract lengths beyond what was required for the rating.

13. Conversations with decision-makers suggest that this adjustment occurs on a rating-specific basis; when Navy planners perceive that the demand for the rating is high and potential sailors are lined up to enter the rating, planners may increase the length of the contract in response. Economic conditions are likely to play a role in this as well.

Of course, the foregoing figures are simple descriptive statistics; we explore the relationship between contract length and attrition in more depth in the results section. At the same time, we recognize that there is little research examining the extent to which available contracts serve to expand or contract the market; therefore, we also test the relationship between contracts available and the likelihood that highly qualified potential sailors enlist. We need to determine the sizes of both of these effects, and the extent to which the effects are different under different economic conditions, before we can make recommendations about the optimal contract strategy. In the next section, we explore the effects of contract length on accession, rating, and attrition in turn.

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Results

In this section, we present our empirical results. We begin by estimating the probability of entering the Navy as a function of individual characteristics, economic factors, and contract lengths available. Next, we explore the role of longer contracts and bonuses in skill channeling. We then present estimates of the probability that a sailor will elect a longer contract than required. This model also includes individual characteristics and economic factors as well as contract length and bonus structures available at the time of enlistment. Finally, we explore the relationship between contract length and first-term attrition.

Who enlists in the Navy?

Changing contract length could change the probability that an applicant will enter the Navy; in particular, the literature suggests that increasing the contract length should make Navy service less attractive. To measure the likely size of this effect, we model the probability of enlistment as a function of contract length offered and current civilian conditions as well as personal characteristics.

Recall that our initial data file included all applicants who entered a Military Entrance Processing Station with the intention of joining the Navy in the FY03–FY12 period.[14] Our sample includes about 784,000 people; the number of applicants per year varies between 68,000 and 93,000. Figures 1 and 2 (presented earlier) detail the marked increase in applicant and accession quality over this time period.

Because we are interested in estimating the probability that a potential applicant chooses to enter the Navy and the extent to which this

14. We include only data through FY10 in our estimates; this restriction means that our applicant data mirror our accession data (discussed in the next subsection).

probability depends on the contract lengths available, we would like to screen out those who are most likely to be *ineligible* to enlist. We do this by focusing on three major requirements: education credential, AFQT score, and weight-for-height or Body Mass Index (BMI). Specifically, we create a variable indicating whether an applicant has any of the following barriers to enlistment:[15]

- Education credential considered Tier 2 or 3 (not a high school graduate)
- Likely to exceed body fat standard (we approximate this based on having a BMI that exceeds 33)[16]
- Missing height and/or weight information (generally indicates that the applicant left the MEPS before completing the physical portion of enlistment; these applicants have not spoken to a classifier and thus are unlikely to be influenced by contract/rating availability)
- AFQT score of 35 or less

Some enlistees do have at least one of these barriers, but enlistment levels among those with no barriers are about 68 percent compared with less than 10 percent for those with at least one barrier. Across our sample, slightly more than 40 percent of applicants have at least one barrier to enlistment.

We estimate our models with the complete sample, and excluding those facing barriers to enlistment. We also estimate separate models for FY03 through FY07 and for FY08 through FY10. We create this

15. In the appendix, we discuss each of these indicators in more detail and provide information on the number of applicants falling into each category.

16. This is a generous limit. In general, those with a BMI of 28 or more exceed Navy weight standards (and tall women who have BMIs in the range of 26 to 27 exceed standards). However, those who exceed the weight standard are still eligible to enlist if their measured body fat is below the limit of 22 percent for men and 33 percent for women. We have no data on body fat, so we use the relatively generous limit of BMI = 33.

distinction because of the substantial changes to both the civilian labor market and the Navy's bonus/contract length programs in 2007 and 2008. Finally, we estimate a series of models based on applicant quality, using the quality measures introduced earlier (A-cell, technically qualified, and highly qualified).

Our analysis focuses on a sailor's choice of contract length. It is notable, then, that we do *not* observe the complete set of contracts offered to each sailor. Our interactions with Navy classifiers[17] at two MEPSs lead to two observations about the bundle of jobs offered to each recruit: recruits are typically offered only a small subset of the jobs for which they are eligible, and this bundle seems to depend heavily on the classifier's knowledge of Navy needs and his or her opinion of the jobs that recruits will find most attractive. Although the classifiers' judgments make sense on a practical level—these judgments may well lead to the most efficient sorting of recruits into jobs—the lack of data records on the exact set of options presented to each recruit created a barrier to our analysis. We determined that we would likely be unable to derive the bundle offered each recruit using only their observed characteristics and the rating and contract length that they ultimately accepted. Preliminary analysis supported this notion: we were unable to consistently predict which rating a sailor would ultimately choose given only his or her characteristics.

However, given that we *do* know the distribution of contract lengths in signed contracts in a given month, we can use this information in our analysis. We use observed contract lengths to calculate the rating-specific proportion of contracts signed that were five or six years in length. We calculate these percentages for each month, based on the date that the potential applicant entered a MEPS. First, we calculate the percentages of contracts signed that were five, and six, years in length based solely on rating. (In other words, we calculate how many sailors entered ratings with five-year, and six-year, obligations in a given month.) This measure is meant to control for the variation in

17. Navy classifiers are responsible for negotiating rating choice for each recruit. Recruits are generally internally committed to joining the Navy by the time they reach this part of the enlistment process (at least in the current environment).

ratings filled during each time period. On average, 20 percent of sailors have a six-year contract due to the rating selected; about 17 percent have a five-year contract. We also calculated the percentage of ratings that were five, and six, years in length due to initial extensions. This measure indicates how many sailors were likely to be offered bonuses to extend the length of their contracts. In our data, about 8 percent of sailors have a six-year contract with a rating that requires a shorter obligation, but 15 percent of sailors add an extension onto their four-year obligation to end up with a five-year contract. This variable captures the availability of bonuses in exchange for additional obligations. Either measure of contract length could theoretically influence the likelihood that an applicant decides to enlist. We tested specifications including each measure as well as specifications including both; our final specification includes both.

Therefore, our regressions control for the overall Navy demand for sailors in ratings with longer contracts, and for the overall offering of bonuses coupled with initial contract extensions. Finally, we include a measure of the ratio of likely qualified applicants to the total number of accessions. This measure, calculated on a quarterly basis, is meant to control for the extent to which there are many (or few) qualified sailors attempting to enter the Navy.[18]

Along with the availability of contract lengths and bonuses, we model the probability of enlistment as a function of personal characteristics, and a series of dummy variables indicating the applicant's home state, the fiscal year, and the quarter of the year. Personal characteristics include gender, ethnicity, age, marital status, and education credential. We experimented with numerous specific state-level measures (as opposed to the series of state-level dummy variables that we use in our final specification); in particular, many of our earlier specifications included various measures of unemployment, and some included number of new unemployment claims, average tuition and fees at

18. We calculate likely qualified applicants based on the following criteria: Tier 1 education credential (high school diploma or equivalent) *and* AFQT score of at least 50 *and* BMI of no more than 33. We divide this number by the total number of accessions in the same quarter. This measure varies from 0.70 to 1.2 in the period covered by our data.

four-year public postsecondary institutions, and average wages. These variables tended to have very small correlations with accession but often are highly correlated with each other and with state-level fixed-effects variables. Overall, we found that most state-level measures did not add appreciable explanatory power to the model; based on this, and on the fact that many of the state-level measures are available over a more limited time span than our data, in the results that follow we include only state-level fixed effects rather than state-level variables. We also cluster the standard errors at the state level. (This is to correct for any correlations at the state level).

In our preferred estimates, we model the probability that an applicant will enter the Navy—specifically, the probability that the applicant will actually ship to bootcamp.[19] In general, we find that the contract length offered has no practical influence on the probability of entering the Navy. This remains true if we look at the entire sample, if we limit to applicants without barriers, or if we look at higher quality applicants (A-cells, technically qualified, and highly qualified). Finally, the small effect of longer contracts holds in both time periods.

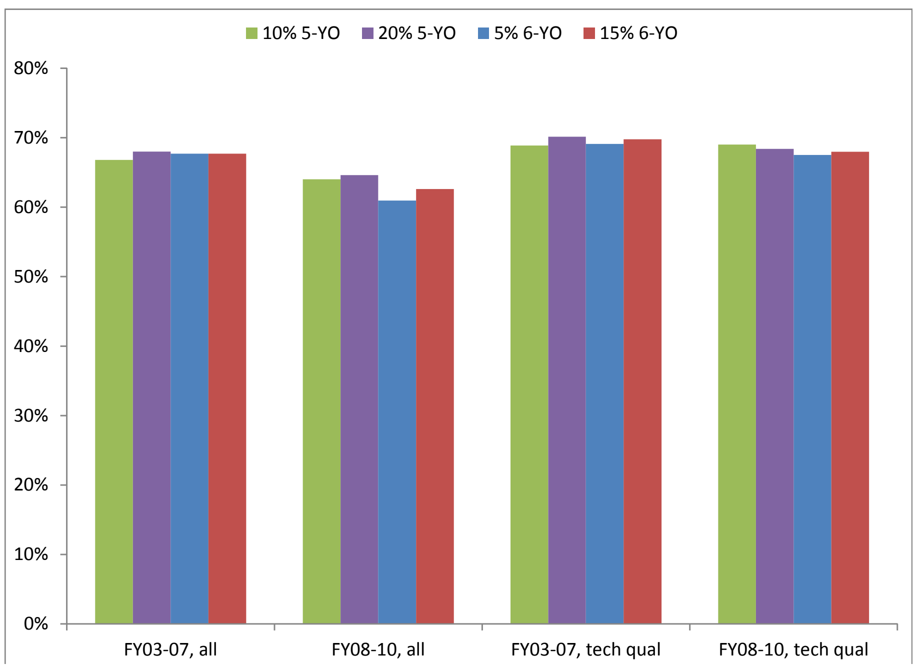
Figures 9 and 10 present marginal effects based on changing the proportion of rating-specific five- and six-year contracts, as well as changing the proportion of contracts that include initial extensions and thus become five- or six-year obligations. In each case, we calculate the change in the probability of accession if the proportion of contracts of a specific length changes. In all cases, we calculate our change around the mean, generally by altering the proportion of contracts by around 2 standard deviations. Thus, we measure the change in probability of accession in response to a sizable and historically large change in the distribution of contracts.

Figure 9 focuses on rating-specific contract lengths; as the Navy changed the proportion of ratings requiring five- or six-year contracts, figure 9 indicates that there were no substantial changes in the

19. Some applicants enter the DEP but do not actually enter the Navy; we modeled DEP entry as an alternate outcome and found that our results in the most recent time period appeared slightly more sensitive to contract length changes, probably because of the large DEP pool. In other ways, our results were qualitatively similar.

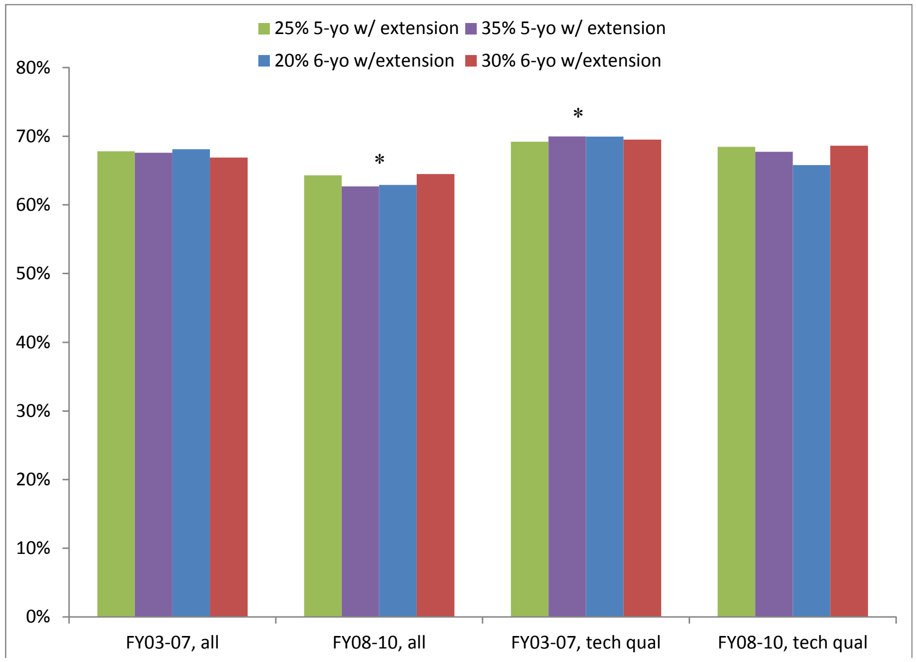
probability of accessions. (We perform these calculations by changing the proportion of five-year contracts from 10 to 20 percent, and by changing the proportion of six-year contracts from 5 to 15 percent.) All differences are small and none are statistically significant, suggesting that all are likely the result of chance. In the interest of brevity, we do not present all specifications; however, the results were completely consistent across specification. Whether we include or exclude those facing barriers to entry, whether we select on A-cell or even more highly qualified applicants, there is no evidence that the probability of accession is correlated with the availability of ratings with longer or shorter contracts.

Figure 9. Marginal effects: Probability of accession by rating-specific contract length mix, time period, and technical skill[a]



a. None of the differences are significant at the 5-percent level. Sample includes those who do not have significant barriers to entry (all in the sample have a high school diploma or equivalent, an AFQT score of at least 35, and a BMI of no more than 33. *Technically qualified:* High school diploma or equivalent credential **and** AFQT score of 67 or higher. Models also control for gender, ethnicity, age, marital status, education, enlistment bonus, quarter of application, fiscal year of application, and home state. Finally, models include a measurer of the ratio of likely qualified candidates to the overall number of accessions. Standard errors clustered at the state level.

Figure 10. Marginal effects: Probability of accession by additional obligation contract length mix, time period, and technical skill[a]



a. * indicates that difference is significant at the 5-percent level or better. Sample includes those who do not have significant barriers to entry (all in the sample have a high school diploma or equivalent, an AFQT score of at least 35, and a BMI of no more than 33. *Technically qualified:* High school diploma or equivalent credential **and** AFQT score of 67 or higher. Models also control for gender, ethnicity, age, marital status, education, enlistment bonus, quarter of application, fiscal year of application, and home state. Finally, models include a measure of the ratio of likely qualified candidates to the overall number of accessions. Standard errors clustered at the state level.

Figure 10 presents similar marginal effects, but now we focus on the proportion of ratings that included a bonus to extend a shorter contract for an additional year (either to five or to six years total). We perform these calculations by changing the proportion of initial extensions to five years from 25 to 35 percent, and the proportion of initial extensions to six years from 20 to 30 percent. In each case, this represents a historically large change, something on the order of 2 standard deviations. Resulting differences in the probability of accession are small and only 2 are statistically significant. Again, in the interest of brevity, we do not present all specifications; however, the results were completely consistent across specifications. Whether we include or exclude those facing barriers to entry, whether we select on A-cell or even more highly qualified applicants, there is no evidence that the probability of accession is substantially correlated with the availability of ratings with longer or shorter contracts.

There are some interesting differences between figures 9 and 10. First, a careful comparison reveals that accession rates were higher in the FY03–FY07 period than the later period. (Recall from figures 1 and 2 that the number of applicants increased sharply after FY07; this suggests that entry became more competitive.) Also, many of the other variables we include in our specifications had a significant and substantive relationship to accession; for example, men are more likely than women to access and the difference is quite large—in the range of 10 to 15 percentage points.

The main takeaway from figures 9 and 10 is that once we control for other important variables, the contract length mix has only very small effects on the probability of accession in and of itself. This is true when we estimate our outcome on the entire sample, and when we limit to specific quality groups. We interpret this finding as an indication that the Navy has been successful in making longer contract lengths appealing to sailors through incentives and the value of training. Taken together, these results suggest that increasing contract length has virtually no independent negative effects on accession rates; indeed, our results suggest that increasing contract length (especially when accompanied by a bonus) is as likely to increase accession rates as to decrease them.

These results come from reduced-form models. We do not model any specifics of the detailing process; nor do we examine the effects of specific Navy policies (such as Perform To Serve) net of other factors. Rather, we simply estimate how an individual applicant's likelihood of entering the Navy changes when the mix of contract lengths changes.

We recognize that the probability of entering the Navy is influenced by both supply-side and demand-side factors. For example, when the targeted number of accessions decreases, probability of entry will decrease, regardless of applicants' current attitudes toward the Navy or current civilian opportunities. Of course, as attitudes and/or civilian opportunities change, the number of applicants will change as well. Also, the Navy changes the availability of longer contracts and of bonuses based on perceived recruiting difficulties. Therefore, the expected direction of some variables is not clear. In difficult recruiting times, we would expect applicant factors to be more important; in times with excess recruits, this may not be the case. Figures 9 and 10 show that overall accession rates are slightly lower during the later time period despite the increase in applicant quality; this is due to eroding civilian opportunities *and* slightly smaller Navy accession goals. However, our overall results are very similar across time periods and applicant quality. Changes in the availability of longer contracts have only a small correlation with the probability of accession, and there is certainly no reason to believe that higher quality applicants decide not to join the Navy when longer contracts are more prevalent. Next, we shift our attention to those who enter the Navy, and the likelihood of signing a longer versus shorter contract.

Who selects a longer contract?

The enlistment bonus cost of longer contracts

We begin our analysis by directly estimating the observable dollar cost of convincing sailors to accept longer contracts.[20] We do so by estimating the relationship between the size of a contract-lengthening Source Rating Enlistment Bonus (EBSR) and the proportion of sailors accepting that bonus. The EBSR offers applicants the ability to earn a bonus in return for a longer contract. This bonus was typically paid upon arrival at the sailor's first permanent-duty station.

The size of this bonus can vary substantially: we observed EBSRs as low as $1,000 and as high as $40,000 during our sample period (although the $40,000 bonuses are for ratings not included in our samples). EBSR also helped persuade sailors to ship during "less desirable" shipping months (February, March, April, and May (FMAM)) by offering higher bonus amounts during these months. This especially held during the early half of our sample, when the bulk of EBSRs

20. The appendix has a detailed discussion of our sample selection criteria.

offered different amounts for different ship months. This was less common in the later half of our observation period.

Note that EBSR typically does not preclude the acceptance of other bonuses for which a sailor is eligible: it is not uncommon to see people accept both EBSR and Enlistment Bonus for College Credit (EBCC), for instance, and acceptance of both incurs only a single one-year contract extension.

Our goal is to measure the effect of EBSR[21] on the probability that a new sailor will choose an initial extension; thus, we are interested in the relationship between EBSR and contract length.[22] However, there are two major limitations to measuring the effect of EBSR on contract lengths:

- *Measurement error:* Our estimate of the enlistment bonus offered to and accepted by recruits is measured with error.
- *Endogeneity:* Changes in enlistment bonuses likely reflect changes in recruiting conditions.

Measurement error is clearly illustrated in the data: it is not uncommon to see bonus values that differ from those values prescribed by the Navy or bonuses awarded where no bonuses should have been offered. The frequency with which this occurs suggests that neither the observed nor prescribed EB values are measured without error. This will cause our estimates to be "too small" in magnitude. Fortunately, the presence of two EB variables measured with error allows us to correct for this error through a two-stage least squares (2SLS) regression. As a result, to the extent that both of our EB measures have (independent) random noise, we can minimize the impact of measurement error on our estimates.

21. Our analysis is limited to EBSR for sailors without college (the majority of our sample). Sailors with college face the decision of whether to extend for a sum that equals the total of EBSR and EBCC.

22. We use both the EBSR amounts prescribed by CNRC and those recorded in our data in the analysis. Note that some ratings and programs (e.g., NF) do not require a contract extension if EBSR is accepted. We identify and exclude these ratings from our analysis.

The second limitation (endogeneity) is a greater concern for our analysis. As an illustration of the issue, suppose that the Navy anticipates improvement in the civilian labor market and, in an effort to retain the current level of contract extensions, increases enlistment bonuses. If we use this change to try to estimate the effect of changes in enlistment bonuses on the willingness of sailors to accept longer contracts, we will likely find little or no effect (since higher bonuses will have been observed to result in no change in contract length extensions). In reality, however, there will have been an effect: the higher enlistment bonuses will have prevented contract length extensions from falling.

This endogeneity limitation is not something that we can effectively control for in our estimates. As a result, we are mindful of how we interpret our results. In particular, we recognize that our estimates of applicants' responsiveness to a bonus are likely a lower bound for the reasons presented. Furthermore, we are unable to estimate the effect of going from no bonus to an enlistment bonus because the estimate would then include the effect from those who would have been willing to accept for minimal compensation but were offered $1,000.

A final problem that arises is the measurement of offered EBCC for college graduates in our sample who ultimately chose not to accept it. Our dataset does not record the number of credit hours of college each sailor has completed; instead, it lists whether sailors have some college, an associate degree, or a bachelor's degree. Imputation of the offered values of the latter two categories is straightforward. Imputation of the offered values for those who have some college credit and did not accept EBCC is less straightforward because of two possible biases. On one hand, those who were offered more EBCC are more likely to accept it than those who were offered less EBCC, all else equal. This bias would suggest that those who did not accept are likely to have been offered less on average than those who did accept. On the other hand, sailors with more college may be less willing to accept longer contracts. This would suggest that those who did not accept have more college and would have been offered greater-than-average EBCC levels. Since we cannot correct for this bias without additional information, we predict the average value based on EBCC period, race, and citizenship status and then analyze separately those with and without college.

As a result of these problems, combined with our inability to measure the classifier effect, our estimated change in acceptance levels due to a change in the size of an enlistment bonus will be biased toward zero,[23] which means that some of our cost measures will likely be "too high." Nonetheless, we feel that the estimation of a "ceiling" on some of these costs may be useful for decision-making.

As in the previous section, we divide our sample into two time periods. The first, before and during FY07, roughly corresponds with the time period before the recession in the late 2000s. The second, after FY07, roughly corresponds with dates after the beginning of the recession. We make this distinction to measure the effect of bonuses in both "normal" and "abnormal" recruiting environments.

We further divide the sample into technical and nontechnical ratings.[24] We do this in an attempt to identify differences between the responsiveness of high-skill and low-skill sailors because we anticipate that high-skill sailors will be more likely to enlist in technical ratings. This is roughly parallel to our focus on technically and highly qualified applicants in the previous section.

Our regressions estimate the effect of the dollar value of the enlistment bonus on the probability that the bonus and the longer contract are accepted. Included in our model are some other factors that we would anticipate having an effect on the probability of accepting an obligation-lengthening bonus, including various economic factors (e.g., the unemployment rate) and personal characteristics (e.g., AFQT score and educational attainment).[25] As stated earlier, because of data limitations, we look only at changes in existing bonuses

23. The existence of "normal" measurement error leads to an estimate that is biased toward zero. This is generally referred to in the economic literature as "attenuation bias."

24. We categorize ratings as technical and the nontechnical following the general methodology of [27]. See the appendix for more details.

25. See the appendix for a more formal description of the model.

instead of the effect of a new bonus. Our main results are shown in tables 2 and 3.

Table 2. Estimated effect of increasing an existing EBSR by $1,000 on the probability of contract extension for sailors with no college

	Pre-2007		**Post-2007**	
	Nontechnical ratings	Technical ratings	Nontechnical ratings	Technical ratings
EB offered	0.065***	0.076***	-0.013	0.003
	(0.003)	(0.002)	(0.008)	(0.003)
N	11,105	26,461	4,449	11,150

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Standard errors in parentheses
Estimates for other covariates shown in the appendix

Table 3. Estimated effect of increasing the sum of EBSR and EBCC by $1,000 on the probability of contract extension for sailors with college credit

	Pre-2007		**Post-2007**	
	Nontechnical ratings	Technical ratings	Nontechnical ratings	Technical ratings
EB offered	0.053***	0.041***	0.025**	0.019*
	(0.005)	(0.004)	(0.009)	(0.008)
N	4,673	7,324	1,513	2,526

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Standard errors in parentheses
Estimates for other covariates shown in the appendix

We see a sharply defined dichotomy between sailors' estimated response to offered EBSR before and after the recession. Our estimates from before the recession suggest that, during normal civilian economic conditions, increasing an existing EBSR by $1,000 increases the share of sailors without college credit who accept that bonus by 6.5 percentage points in nontechnical ratings and by 7.6 percentage points in technical ratings.

The amount of EBSR offered in both technical and nontechnical ratings (conditional in some EBSR being offered) appears to lose much of its effectiveness during the recession. If anything, this is the opposite of our a priori expectations because the stability of a long-term contract would seem likely to be more valuable during poor civilian economic times than during good times. There are several possible explanations for our estimated effect. The first focuses on the fact that the estimates are conditional on any EB being offered; it may be that sailors are more willing to accept minimal amounts of EBSR during recessions, so increasing EBSR has little effect. This doesn't seem to account for all of the difference in our estimates here, however: while more people would be expected to accept an EBSR of $1,000 during the recession, the total proportion of EBSR-eligible sailors who accept the EBSR is smaller after the recession.

Instead, we suspect that endogeneity problems are affecting our ability to obtain reliable estimates. Note that the number of people offered bonuses is substantially smaller during the recession than before it. As a result, we anticipate that the (likely unobservable) characteristics of these sailors are drastically different from those of sailors offered bonuses before the recession. This endogeneity prevents us from making any strong statements about the effectiveness of bonuses in abnormal recruiting times and highlights the usefulness of a randomized experiment. However, our results from both periods suggest that sailors in technical ratings may be somewhat more responsive to bonuses than sailors in nontechnical ratings.

We can somewhat address some of the endogeneity problems inherent in the above analysis for a much smaller selection of ratings by analyzing the implementation and suspension of the Enlistment Bonus for Extended Enlistment (EBEE). EBEE (introduced on May 17, 2004, and suspended on November 9, 2006) offered $5,000 to a select set of enlistees in return for a six-year active duty enlistment contract. To be eligible, recruits had to enlist in the school guarantee program in one of nine ratings, which typically had four-year default contract lengths and minimal or no EBSR. Sailors accepting EBEE were still eligible to accept all other bonuses for which they qualified.

Table 4 shows the relevant characteristics of ratings that received EBEE.

Table 4. Characteristics of EBEE ratings[a]

Characteristic	**During EBEE period**	**Outside EBEE period**
Percentage accepting EBEE	49.5%	~
Number of contracts	11,053	15,448
Average contract length	5.22 years	4.37 years
4-year contracts	27.5%	63.2%
5-year contracts	23.0%	36.8%
6-year contracts	49.5%	0%

a. All non-6-year default contract lengths, FY03–FY10.

Combined with the average total enlistment bonus amounts, these simple tabulations are enough to generate an estimate of the responsiveness of these individuals to EBEE by comparing the total bonuses paid and total years obligated when EBEE was and was not available.[26] Table 5 shows the resulting cost.

Table 5. EBEE cost per additional obligated year

	EBEE in effect	**EBEE not in effect**
Percentage 5-year obligation (5YO)	23.03%	36.77%
Percentage (6YO)	49.47%	0%
Average total EB: 5YO	$4,642	$5,585
Average total EB: 6YO	$9,298	
Cost per additional obligated year: **$4,226**		

26. Doing so requires an assumption about what contract length choices those in these rating would have made had EBEE not been available. We assume that they would have followed the historical pattern: 63.2 percent in four-year contracts and 32.8 percent in five-year contracts.

In fact, we can generate similar costs using our results from tables 2 and 3. In doing so, we make a distinction between average and marginal cost per obligated man-year. Average cost per man-year compares the bonuses and obligations with contract-lengthening enlistment bonuses in place versus those with none in place; in the latter case, sailors cannot extend their contracts. By definition, the average cost per additional man-year is the average enlistment bonus. The marginal cost per man-year, however, compares two different bonus levels. We will compare the observed average bonus level with one that is $1,000 less. We use the coefficients in tables 2 and 3 to identify how many sailors would have extended at this lower level. The change in total EB cost divided by the change in total obligated man-years will be the marginal cost per man-year incurred by the last $1,000 of average EB.

We also transform the cost per obligated man-year into a cost per realized man-year. To do so, we compute the average first-term length of service (LOS) for both those in 4-year default obligation ratings who do not receive an EB as well as those in these ratings who do receive an EB. For the former, we find an average first-term LOS of 37.32 months; we find an average first-term LOS of 45.94 months for the latter. The 8.63-month difference is equivalent to an additional 0.72 realized man-year per additional obligated man-year. We can then calculate the cost per realized year by dividing the cost per obligated year by 0.72. Table 6 shows the results of these cost calculations.

As table 6 shows, the acceptance rates (and projected acceptance rates) of enlistment bonuses are quite high: the acceptance rates in our sample during this time period hover around 75 percent. The average total cost per obligated man-year is relatively low—between $4,400 and $6,700 (recall that, since sailors cannot extend without these bonuses, the total cost per obligated year is simply the average bonus amount). Note that [14] calculated a marginal cost of $33,600 per additional high-quality recruit using the most cost-effective recruiting resource (additional recruiters); other methods of acquiring new recruits were more expensive. Thus, under the assumption that a new high-quality recruit will obligate for 4.5 years, the cost-per obligated year of a new recruit is more than $7,450, which is well above our estimated average costs of EB.

Table 6. Cost of additional contract length obtained through enlistment bonuses, FY07 and before

	No college credit	**College credit**
Technical ratings		
Average EB	$4,441	$6,078
Average acceptance rate	72.2%	77.1%
Average EB less $1,000	$3,441	$5,078
Estimated acceptance rate of average EB less $1,000	65.9%	71.5%
Cost of an obligated year		
Cost: comparison is no EB (average cost)	**$4,441**	**$6,078**
Cost: comparison is $1,000 less EB (marginal cost)	**$14,792**	**$17,890**
Cost of a realized year		
Cost: comparison is no EB (average cost)	**$6,175**	**$8,451**
Cost: comparison is $1,000 less EB (marginal cost)	**$20,568**	**$24,876**
Nontechnical ratings		
Average EB	$4,478	$6,648
Average acceptance rate	74.7%	77.9%
Average EB less $1,000	$3,478	$5,648
Estimated acceptance rate of average EB less $1,000	68.3%	70.8%
Cost of an obligated year		
Cost: comparison is no EB (average cost)	**$4,478**	**$6,648**
Cost: comparison is $1,000 less EB (marginal cost)	**$15,214**	**$17,196**
Cost of a realized year		
Cost: comparison is no EB (average cost)	**$6,227**	**$9,244**
Cost: comparison is $1,000 less EB (marginal cost)	**$21,155**	**$23,911**
Average LOS, 4-year program, no EB	37.32 months	
Average LOS, 4-year program, with EB	45.94 months	
Average months added by EB	8.63 months	

The marginal cost, or the cost incurred by the last $1,000 in average EB, is higher: between $14,800 and $17,900. The difference between the average and marginal costs is the extra bonus that must be paid to sailors who would have extended for lower amounts. When a bonus is increased, these sailors must be paid the extra bonus, but they do not contribute additional man-years.

We also look at the costs per additional realized year served due to EB. As we mentioned earlier, the difference in realized first-term LOS between sailors in 4-year default obligation ratings who accept an EB and those who do not is 0.72 year. The costs per additional realized year, then, are going to be roughly 39 percent higher than the costs per additional obligated year. Table 6 reflects this: the estimated average cost per realized man-year in technical ratings is $6,175 to $8,451 and is $6,221 to $9,244 in nontechnical ratings. The estimated marginal costs rise to between $20,568 and $24,876 for technical ratings and between $21,155 and $23,911 for nontechnical ratings.

The difference between average and marginal costs also points to the value of a controlled experiment in which the effect of EB size on acceptance of that bonus can be accurately measured. Accurate estimates of the marginal costs of additional obligated contract years at different acceptance levels would make feasible comparisons of the cost of additional man-years through higher enlistment bonuses and through other means (e.g., additional recruits).

One final question remains: how many sailors were offered bonuses during this time period? Between FY03 and FY07, only 55 percent of sailors in ratings that required extensions in return for these bonuses were offered bonuses of any dollar amount. That number falls to 47 percent for our entire analysis period. Given the relatively low average costs implied by both the formal analysis and the EBEE outcomes, we anticipate that additional obligated years of service could have been acquired from these sailors at a relatively modest cost.

Next, we explore the extent to which enlistment bonuses serve to push higher quality sailors into ratings requiring more training or longer contracts.

The skill-channeling effect of enlistment bonuses

One implication of offering enlistment bonuses is the effect of skill channeling, in which offering a bonus may induce higher quality recruits to enlist in the rating for which the bonus is offered instead of a different rating that they would otherwise choose. In fact, this skill-channeling effect can be the primary purpose of enlistment bonuses. However, this skill channeling need not be a positive effect: if bonuses are awarded for longer contracts in ratings that are not difficult to fill, we might see skill channeling from harder-to-fill ratings to the easier-to-fill ones. Next, we attempt to quantify the extent to which this is a concern.

Using the same sample as in the previous analysis, we estimate the effect of enlistment bonuses on skill composition by looking at the EBSR offered in each rating between FY04 and FY10. We calculate for each rating the number of new DEP members who enlisted in that rating during each month. We then divide these new recruits into four distinct categories:

1. *Non-A-cell:* AFQT scores below 50 or non-HSDG
2. *A-cell:* HSDG and AFQT scores between 50 and 67
3. *Technical quality:* HSDG and AFQT scores between 67 and 80
4. *High quality:* HSDG and AFQT scores at or above 80

These categories represent, in order, the least skilled to most skilled sailors in terms of test scores.[27] We will loosely refer to non-A-cell and A-cell recruits as "lower quality" and will refer to technical-quality and high-quality recruits as "higher quality." We then divide ratings into technical and nontechnical categories. (See the previous subsection, and the appendix, for more details about how we determined our list of technical versus nontechnical ratings).

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27. While we use the same definitions as in the previous section, here we classify each sailor into exactly one of these categories to measure the proportion of sailors in each category/rating cell.

We begin our analysis by calculating, for each month, the proportion of each rating's recruits that qualify as one of the above four categories. We then calculate monthly averages for other rating-specific variables that we think might affect the proportion of a rating that falls into each category. Three variables are of particular interest:

- The average prescribed EBSR for each rating in each month
- The average prescribed EBSR for similar ratings, where similar denotes the same technical/nontechnical categorization
- The average prescribed EBSR for dissimilar ratings, where dissimilar denotes the opposite technical/nontechnical categorization

We then estimate the effects of these average bonus levels on the percentage of the recruits in that rating that qualify as each quality type. Table 7 illustrates the percentage-point change of different quality types in ratings in response to a change in EBSR.

Table 7. How does EBSR affect percentage of skill type in ratings?

Change in EBSR offering	**Non-A-cell**	**A-cell**	**Technical quality**	**High quality**
Offered	-0.013*	-0.007	0.009**	0.011*
	(0.005)	(0.004)	(0.003)	(0.004)
Offered in similar ratings	0.020*	0.003	-0.011**	-0.012**
	(0.009)	(0.007)	(0.004)	(0.004)
Offered in dissimilar ratings	-0.005	0.007	-0.001	-0.002
	(0.009)	(0.005)	(0.003)	(0.003)

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors are in parentheses. EBSR variables are in thousands of dollars.

These estimates indicate that introducing or increasing an EBSR for a specific rating is correlated with a higher share of high-skill recruits enlisting in that rating (relative to low-skill recruits). Specifically, we estimate that increasing EBSR by $1,000 is correlated with an increase in the proportion of technical and high-quality recruits enlisting in the rating by 0.9 and 1.1 percentage points, respectively. This influx of high-skill recruits is mirrored by a reduction in the proportion of low-skill recruits enlisting in the rating: the same $1,000 increase in EBSR results in 0.7 and 1.3 percentage points fewer A-cell and non-A-cell recruits, respectively.

It is not surprising that we see the opposite when the EBSR increase occurs in a different but technically similar rating. Holding constant EBSR in a specific rating, increasing average EBSR in similar ratings by $1,000 reduces the proportion of high-skill enrollees and increases the proportion of low-skill enrollees in that rating. Specifically, we estimate that the proportion of enlistees in that rating who qualify as technical and high quality will fall by 1.1 and 1.2 percentage points, respectively, while the proportion that qualifies as A-cell and non-A-cell will rise by 0.3 and 2.0 percentage points.[28]

Taken as a whole, these estimates may seem puzzling: why would relatively low-skill sailors seem to dislike EBSR? In light of other factors, however, these estimates tell a coherent story. First, note that there are limits on the number of sailors that can enlist in any specific rating. As such, an EBSR that entices high-skill recruits to enlist in that rating will cause low-skill recruits to be "forced out" of the rating. Further, it will create new vacancies in ratings that would, in the absence of the EBSR, be filled by the high-skill recruits. The low-skill recruits, needing a rating, fill these vacancies. Finally, we would expect a smaller response to EBSR changes in dissimilar ratings simply because those ratings are likely to be farther away from the non-EB attributes of the "original choice" of recruits than are the non-EB attributes of dissimilar ratings.

To summarize, EBSR has a small but statistically significant relationship with quality; the existence of an EBSR in a rating is associated with larger proportions of technically and highly qualified sailors. In

28. We generally estimate smaller effects for average EBSR changes in dissimilar ratings—the exception being A-cell enlistees, whose point estimate is actually larger for dissimilar ratings than for similar ones. (These estimates are relatively imprecise, however: a formal statistical test fails to reject that the estimates for similar and dissimilar ratings are different at traditional confidence levels.)

contrast, when similar ratings have EBSRs, those ratings without EBSRs see lower levels of technically and highly qualified sailors. Next, we explore the relationship between contract length and performance.

How does contract length affect performance?

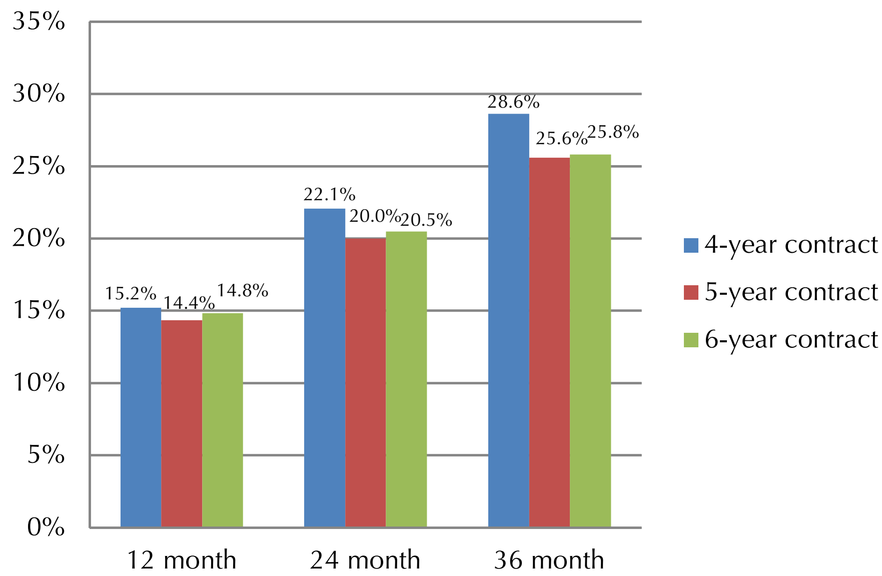
There are many potential measures of performance in the Navy. Examples include striking for a rating, achieving a technical rating, and achieving promotion faster than peers. However, measures such as these require several years' worth of data on each sailor. In this subsection, we focus primarily on a simpler measure that is available fairly early in a sailor's career: first term attrition.

How do sailors respond to a choice of contract lengths?

As discussed above, contract length (and bonus) changes generally occur for a reason. Also, sailors in longer contracts differ from sailors in shorter contracts in a number of ways that are likely to correlate with attrition (refer back to table 1). Consistent with this, figure 11 demonstrates that sailors in longer contacts have lower attrition than sailors in shorter contracts.

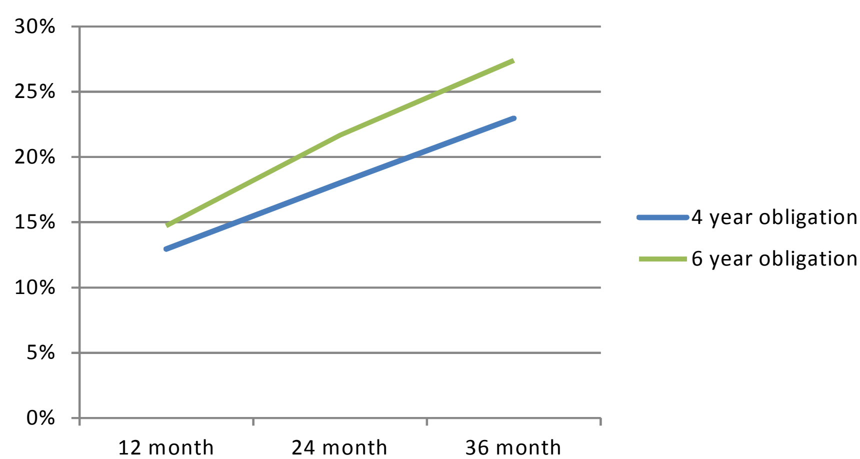
The differences in figure 11 may be related to contract length but also are likely to be related to other personal characteristics, such as age and education. However, we do have one "natural experiment" that may help us begin to answer the question of how changes in contract length affect performance. In five ratings (CTT, HT, IT, IC, STG), multiple contract-training packages have been offered. In each of these ratings, sailors chose between a 4-year contract with less training and a 6-year contract with more training. In figure 12, we present the attrition results of sailors in these five ratings. The figure indicates that those sailors who chose a longer contract (and more training) have slightly *higher* levels of attrition. This result is unexpected based on our descriptive statistics in the prior sections; in general, sailors in longer contracts have characteristics that are associated with lower attrition. The difference in attrition rates by contract type in figure 12, however, is small; in simple regressions the difference is insignificant, suggesting that it could be caused by chance. We interpret these

Figure 11. Attrition rates by contract length[a]



a. Excluded are all ratings with a default 6-year obligation. Data are from FY03–10. Attrition differences between 4- and 5-year contracts are statistically significant at the 1-percent level or better, as are those 24- and 36-month attrition differences between 4 and 6 year contracts. Differences between those with 5- and 6-year contracts, as well as 12-month attrition between 4- and 6-year contracts, are not statistically significant at the conventional levels.

Figure 12. Attrition rates of sailors in five ratings, by contract length[a]



a. Ratings: CTT, HT, IC, IT, STG.

results to indicate that changing the contract length in a particular rating is unlikely to have a large impact on the attrition rate in that rating. However, these results also suggest that it may be worthwhile to explore this topic in more detail. Next, we use more sophisticated analyses to measure the relationship between contract length and performance.

The impact of an obligation-lengthening bonus on attrition

One concern with offering bonuses and extending contracts is the potential effect on first-term attrition. There are several channels through which attrition might be affected:

- Longer contracts lead to more injuries/medical disqualifications during the first term.
- Bonuses induce people to accept the bonus and then attrite shortly thereafter.
- Bonuses induce people to accept contracts in ratings that they dislike. As a result, these people are more likely to attrite.
- Offering bonuses could increase the morale of new enlistees, reducing their attrition.

Our analysis examines the dual effects of implementing a voluntary bonus and a contract extension, without attempting to separate these two effects.

We examine the 45-month attrition (defined as failure to complete more than 45 months of service) impact of offering a bonus and extension. Our goal is to use EBEE to examine the impact of this offered bonus on attrition trends. Two important caveats are worth emphasizing. First, any changes (or lack thereof) that we observe in attrition will result from sailors voluntarily selecting the longer contract in return for a bonus. As such, these results are not applicable to across-the-board mandatory changes in contract length, regardless of whether these changes are accompanied by compensation packages. Second, we cannot use this analysis to isolate the effect of either longer contracts alone or enlistment bonuses alone. Our aggregate estimates could disguise individual effects that are quite different. If, for instance, we estimated no effect on attrition, we would be unable to rule out longer contracts causing greater attrition and larger bonuses causing less attrition.

Our empirical strategy for estimating the attrition consequences of offering EBEE is intuitively straightforward. In essence, we want to compare average first-term attrition of sailors enlisting in these ratings while EBEE was in effect with that of sailors enlisting in these ratings when it was not. The problem with looking at a raw difference in means (even when controlling for sailor quality) is that the difference may or may not be attributable to the event of interest. It is possible that changes in the civilian labor market or Navy conditions could have affected attrition during this time period for reasons unrelated to the availability of EBEE. We would like to isolate these outside effects from the EBEE effect on attrition.

One strategy that is commonly employed in the economic literature to analyze this type of situation is a difference-in-difference (DD) approach. The key to DD is finding a group that is similar enough to the group of interest to experience all of the same "outside" changes but is unaffected by the event being studied. This group is called the control group. Once a valid control group has been identified, we can examine how its mean attrition changed during the time that EBEE was offered. If the control group was truly unaffected by EBEE, we subtract this change from the original difference-in-means of the affected ratings to isolate the effect of EBEE on attrition.

The last hurdle in our analysis is the identification of a valid control group. Key to this identification is that all but one of the EBEE ratings are technical ratings. We thus consider two possible controls:

- Sailors enlisted in other technical ratings
- Sailors enlisted in other nontechnical ratings

Each of these controls is less than optimal in some sense. As we have already shown, EBSR in technical ratings draws in higher skilled people from, and pushes lower skilled people to, other technical ratings. This is a concern for the first control: using sailors in other technical ratings as a control group will be problematic if drawing in more highly skilled workers affects the attrition rates of other technical ratings. While sailors in nontechnical ratings seem likely to be unaffected by EBEE, sailors in nontechnical ratings are more likely to be lower quality recruits. The problem with using sailors enlisted in nontechnical ratings is that this control group seems likely to be a worse reflection of what would have happened to the EBEE ratings in the absence of the introduction of this bonus. Ultimately, we estimate our model twice—once with each control group.

Table 8 displays our estimate of the effect on 45-month attrition of offering EBEE.

Table 8. Effect of the availability of EBEE on first-term attrition

	Control group	
	Other technical ratings	**Nontechnical ratings**
EBEE effect	0.007	0.019*
Standard error	(0.009)	(0.009)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our results suggest that the offering of EBEE had a relatively small effect on attrition—less than 1 percentage point and statistically insignificant when compared with other technical ratings and about 2 percentage points and statistically significant when compared with nontechnical ratings. These findings are consistent with that in [15], which finds a very small and statistically insignificant effect of enlistment bonuses on attrition in the Air Force.

In conclusion, despite examining several different groups using somewhat different strategies, our results consistently suggest that the effects of longer contracts on first-term attrition are likely to be relatively small in nature.

Conclusion

In this research, we examine the consequences of changing first-term contract length. We focus our attention on what happens when first-term contracts increase in length. Our dataset includes information from two very different time periods: the years immediately preceding the most recent recession (FY03–FY07) and the years since the recession began (FY08–FY10). Civilian opportunities were, of course, markedly different after the beginning of the recession. Indeed, we find that the quality of applicants, and of new accessions, increased substantially over this period as civilian opportunities eroded.

Throughout much of the last decade, but especially before the recessionary period, the Navy offered bonuses to many new sailors in exchange for longer first-term contracts. For this reason, contract length statistics based on rating-specific contracts do not accurately portray many sailors' obligations. These "initial extensions" provide an opportunity to measure the sensitivity of new sailors to contract length.

Overall, we find minimal responses to changes in contract length. While there are differences in responses before and after the recession began, even when civilian opportunities were relatively strong, many sailors were willing to extend their initial contracts in return for a bonus. Our estimates suggest that the cost of these initial extensions is modest (between $4,000 and $7,000 per obligated year in the period examined, with a high acceptance rate at these levels) and that the cost of increasing *existing* bonuses, even in an environment with relatively high acceptance levels, fell between $14,700 and $18,000 per obligated year. While a complete cost-benefit analysis is beyond the scope of this work, our figures are relatively modest when compared with the cost of increased man-years via other vehicles, such as base pay (e.g., see table 47 in [14]). After the recession began, our results suggest that bonuses became *less* effective as a tool for increasing contract length. We interpret these results in light of the policy responses at the time; the Navy sharply decreased the number and value of bonuses after the recession began but the number of applicants, and the number of technically qualified applicants, increased, causing bonuses to appear ineffective. A well-designed pilot program would be the most helpful tool for understanding more about the relationships between bonuses, civilian opportunities, and contract length. We lay out some parameters for such a program in a companion document [1].

Bonuses will, of course, cause some skill channeling between ratings. However, we note that, after the recession began, there was arguably less need for skill channeling because overall applicant and sailor quality increased markedly.

In case applicants were discouraged by longer contracts, we modeled the probability of accession conditional on contract length available, personal characteristics, and other factors. Our results suggest that everything else held constant, longer contracts are not perceived as a negative factor by applicants; indeed in some cases applicants were more likely to enlist when longer contracts were offered. That is, the Navy has succeeded in making these longer contracts attractive to recruits through incentives and the value of training. We found, as expected, that barriers to enlistment (education, AFQT score, and weight) are highly predictive of enlistment; applicants who face no barriers are much more likely to enlist. However, whether we select on those facing no barriers or estimate our models on all applicants, the probability of enlistment is not related to the availability of longer contracts in any meaningful way. This result holds whether we examine contract lengths as required by rating or contract extensions available with a bonus. However, we are estimating reduced-form equations; we do not explicitly model the detailing process or any other Navy policies in place during this time period. Again, we suggest that a well-designed pilot program could help to discern how applicants with various characteristics react when offered a longer contract with or without a bonus.

Finally, we find very little evidence that changing contract lengths will drive attrition. In our models, increasing contract length (with a bonus) had a small and insignificant effect on the probability of attrition. In the five-rating "natural experiment" we track, longer contracts are associated with somewhat higher attrition, but the difference is neither statistically nor substantively significant in regression equations. Thus, there is no reason to expect that changing contracts will have a substantial effect on attrition. In particular, the attrition differences associated with contract length differences are much smaller than those associated with, for example, education credentials.

Taken as a group, our results suggest that aligning contract length with sea tour length could result in substantial efficiency gains. Even during periods of time in which the civilian economy is relatively strong, it seems quite possible to induce new sailors to extend initial contract lengths through fairly cost-effective bonuses. One potential policy recommendation that comes from our findings is that offering sailors *voluntary*, if incentivized, options to increase obligation is a riskless way to try to accomplish a higher sea tour completion rate. On one hand, we have shown that bonuses are cost-effective. On the other hand, because the extensions would be voluntary, we would not anticipate that such a policy would have negative impacts on recruiting or retention.

The T+X program, which lengthens initial obligations for a few 4YO ratings, started in FY11 and has been approved to expand from 4 to 15 ratings in FY13 and FY14 total. Even though we offer some early analysis of the program in the companion document [1], it has not been in place long enough to draw conclusions about its impact. As the economy recovers, recruiting of sailors and their performance in the T+X ratings will help further inform the trade-offs associated with obligatory longer contract lengths.

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Appendix: Supplemental information

Here we describe details about our datasets and the decisions we made in coding the variables of interest. We also include many details about our empirical models, and full regression results for our models focusing on enlisted sailors.

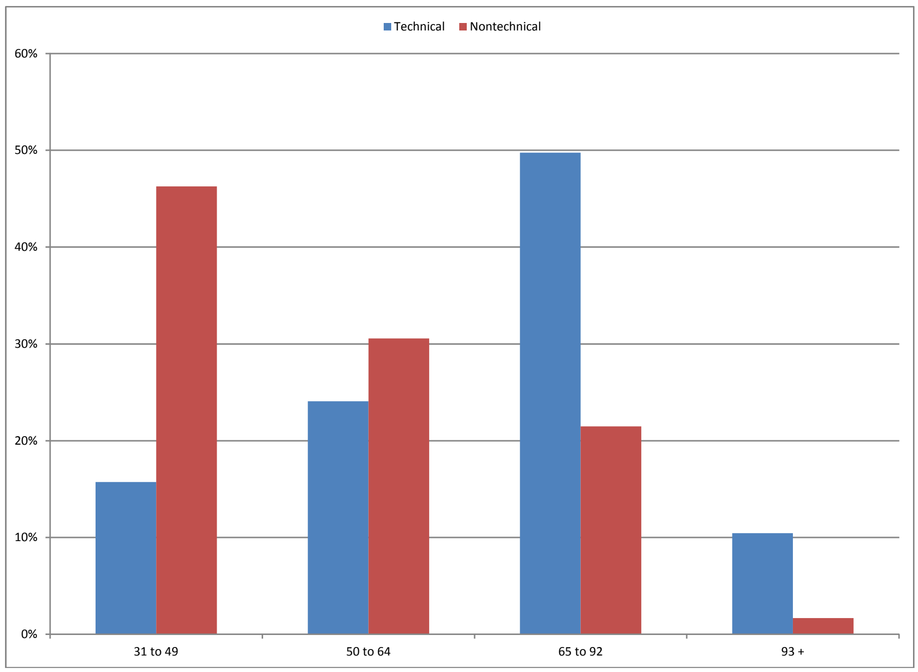
Technical versus nontechnical ratings

Our groupings generally follow [3], but we have updated the information to reflect changes in ratings/obligations. The technical/nontechnical distinction is based on the amount of training and years of obligation. Administrative ratings are nontechnical. Aviation and Aircrew ratings are technical, with the exception of Aviation Boatswain's Mate ratings and Aviation Administration ratings. Sonar Technician, Medical, and Intelligence field ratings are technical. Cryptological ratings are technical, with the exception of Cryptological Communications. Special Operations and Ordnance ratings are technical, as are Construction and Engineering ratings. Engineman, Gas Turbine, Machinist Mate, and Hull Technician ratings are all considered technical. Other ratings not specified in this list are considered nontechnical. We use the same rating-specific definitions in the enlistment file.

Figure 13 gives the AFQT distribution of those in technical and nontechnical ratings. Although there is significant overlap between the groups, figure 13 also clearly demonstrates the difference in measured cognitive skills between those in technical and nontechnical ratings. In particular, those entering technical Navy ratings are far more likely to have AFQT scores in the upper third of the distribution, while those entering nontechnical ratings are more likely to have scores in the middle third of the distribution (in general, those scoring in the bottom third of the distribution are not eligible to serve in the Navy).

Of course, this distribution is driven by the different requirements across the different ratings. But we did not explicitly consider ratings' requirements when dividing ratings into technical and nontechnical categories; therefore, figure 13 demonstrates that our division of ratings into technical and nontechnical accords well with the rating requirements.

Figure 13. AFQT scores, sailors in technical versus nontechnical ratings[a]



a. Based on CNA's PRIDE files. Data include all accessions FY03–FY10.

Applicant data

In this subsection, we describe the decisions we made in the process of preparing our applicant data for analysis. Because we are interested in determining the effect of contract length on enlistment, the goal is to produce a dataset including people who are likely to be eligible to enlist. We know that many applicants who arrive at the Military Entrance Processing Station (MEPS) are not eligible to enlist; we retain information on these people but code key variables to reflect their likely eligibility. We begin, however, with a discussion of outliers and missing data.

Outliers and missing data

Our initial data file included all applicants who entered a MEPS with the intention of joining the Navy during FY03 through FY12.[29] In total, the file includes nearly 803,000 non-prior-service observations.

Our dataset is formed from three separate files: an accession file, a DEP file, and an applicant file. There are far more entries in the applicant file than in the other two, and some who enter DEP do not enter the Navy. In most cases, however, the information across the files is consistent. When one file is missing data unexpectedly, we use information from the other files; for example, when a person who enters the Navy has no information on race/ethnicity, AFQT score, education, height, weight, or age, we take that information from the DEP file. (If the information is missing in both the accession and DEP files, we take the variable from the applicant file.)

We code obvious outliers as missing. Examples include ages of 16 or 40 and older, heights of greater than 80 inches or less than 56 inches, weights of less than 80 pounds or greater than 500 pounds, and Body Mass Indexes (BMIs) of less than 15 or greater than 50.[30] We believe that many of these values are data-entry errors; for example, 15 people accessed into the Navy with listed heights of 14 inches or less and another 15 accessed with listed heights of 93 inches or more. For completeness, we assign the median value to each person who is an outlier in terms of age, height, or weight. (If the information is

29. The information is drawn from the Defense Manpower Data Center (DMDC) MEPCOM files. We thank Marisa Michaels of DMDC for carefully preparing the initial file.

30. BMI is a commonly used weight-for-height measure; the formula when weight is measured in pounds and height in inches is as follows: BMI = (weight*703)/(height*height). In general, applicants with a BMI of over 27.5 (or 25 for tall women) must be measured for body fat; those who exceed the body fat standards are not eligible to enlist. We discuss these standards in more detail later in the appendix.

missing, we assign an age of 19 to all with missing ages; we assign height, weight, and BMI, respectively, of 64 inches, 138 pounds, and 23.7 for women, and 69 inches, 164 pounds, and 24.2 for men.) We use dummy variables to indicate missing values.

We code AFQT scores of 0 as missing. We assign a value of 55 to applicants who have no AFQT score or a score of 0. As in the foregoing cases, we create a variable to indicate that the AFQT score was missing. Relatively few applicants have a score of 0 or missing; this group includes about 2,800 people across all years, the vast majority of whom do not enter the Navy. This suggests that some applicants decided not to complete the application process before or during the ASVAB/AFQT exam.

We exclude Navy reservists but retain people who initially intended to enter the reserves but who actually entered the active duty Navy. Some people have multiple observations; most with multiple observations have two or three, but some people appear as many as eight times. For those who entered the MEPS multiple times, we keep the latest MEPS entry, unless the person entered the Navy on an earlier trip to the MEPS. In cases when all dates were duplicated, we keep only one observation.

These exclusions left us with about 784,000 people who entered a MEPS sometime within FY03 through FY12 with the intention of joining the Navy. There is some variation in the number of people who enter a MEPS in a given year; over the sample period, between 66,000 and 87,000 people visited a MEPS to join the active duty Navy.

Our goal with the applicant file is to determine the effect of contract length on likelihood of accession. Thus, we are interested in how applicants respond to longer versus shorter contracts. However, many of our applicants have substantial amounts of missing data, suggesting that they did not complete the application process, often because they did not meet basic eligibility criteria. Those who do not complete the process are unlikely to make a decision based on contract length because they will not have reached the point in the process that includes consideration of specific ratings/contract lengths. Therefore, we attempt to determine which applicants have substantial barriers to enlistment and/or are ineligible to enlist. We discuss eligibility in terms of AFQT scores, education credentials, and height/weight/body fat.[31]

Applicants who do not complete the accession process

When we compare the frequency of missing variables, we find that AFQT and education are missing for less than 0.5 percent of applicants. In contrast, 7 percent of applicants are missing age and just over 30 percent are missing height and/or weight. (In nearly all cases, applicants who are missing height are also missing weight, and vice versa.) This suggests that many applicants leave the MEPS before being measured for height and weight, possibly because they do not meet the minimum AFQT/education requirements. Consistent with this, about 38 percent of applicants who are missing height/weight data scored below 31 on the AFQT; another quarter scored between 31 and 49. Those who score below 31 are not eligible to enlist, and many who score below 50 are either ineligible (if they do not hold a high school diploma or equivalent credential) or are ineligible for many Navy ratings. (Substantial numbers of applicants with height/weight data also scored between 31 and 49 on the AFQT, but less than 2 percent of applicants with height/weight data scored 31 or below on the test.) Thus, scoring 31 or below on the AFQT virtually guarantees that an applicant will not enter the Navy, and very few applicants scoring below 35 enlist. This is consistent with policy.[32]

About 93 percent of applicants have a Tier 1 education credential (a high school diploma or a credential considered equivalent, or some college). About 5.5 percent hold a Tier 2 credential (most commonly a General Educational Development (GED) certificate), and just over 1 percent have no recognized credential (Tier 3). Tier 1 credentials are preferred because those who hold Tier 1 credentials have much lower attrition rates over the course of the first term (see, e.g., [27]).

31. There are other reasons for ineligibility. Examples include other health conditions, as well as unwaiverable judicial records. We do not have specific information on these determinants, so we focus on the determinants we know and can characterize in terms of likely eligibility.

32. DOD policy restricts the enlistment of those scoring 30 or below; the services may, and generally do, require a higher minimum score.

The most prominent Tier 2 credential is the GED credential. Enlistees who hold a Tier 2 or 3 credential are required to have higher AFQT scores than other enlistees.

Navy accession standards are based on body fat, not height/weight. However, measuring body fat is time-consuming, so weight-for-height limits are used as an initial screen. Those who exceed the weight-for-height limits are measured for body fat; those who exceed the body fat standard (22 percent for men, 33 percent for women) usually are ineligible to enlist.[33] The weight-for-height standards track roughly with BMI measures of 28.5 for men and 25 to 27.5 for women. However, we see fairly substantial numbers of accessions who exceed these BMI figures, and who exceed the specific weight-for-height limit. We find that, above BMI measures of approximately 33, both men and women are quite unlikely to enlist. Therefore, we use this as a rough measure of exceeding body fat standards.

To summarize, failing to meet body fat requirements, scoring less than 35 on the AFQT, or holding an education credential that is not Tier 1 are the most common reasons that applicants do not qualify for enlistment. We create a variable that indicates some likely accession barrier if any of the following are true for an applicant:

- Education credential considered Tier 2 or 3 (not a high school graduate)
- Likely to exceed body fat standard (we approximate this based on having a BMI that exceeds 33)
- Missing height and/or weight information
- AFQT score of 35 or less

At least one of the above conditions holds for nearly 38 percent of our accession sample (almost 300,000 people). We know that our measure of barriers to enlistment is imperfect, but it is highly correlated with enlistment. About 65 percent of those with no barrier to

33. During FY08, the Navy conducted a pilot program that allowed those exceeding the body fat standards by as much as 3 percentage points to enlist. Body fat is also a waiverable condition.

enlistment entered the Navy; about 9 percent of those with a barrier enlisted. We note that some of those who are *missing* height/weight data likely differ from others facing barriers. Many of these applicants left before completing the process. Some likely left the MEPS due to low scores, but others may simply have had a change of heart during the process. Nonetheless, we group all of these applicants together because they are unlikely to have made an enlistment decision based on contract length.

We estimate our accession models with the complete accession sample as described above (about 784,000 people) and with the sample restricted to those who do not have key enlistment barriers (about 490,000).

Enlisted sailors: full results

The enlistment bonus cost of longer contracts

To estimate the willingness of the population to accept longer contracts in return for enlistment bonuses, it is important that sailors in our sample met two criteria:

1. They were eligible to accept an enlistment bonus.
2. They were required to sign longer contracts in return for acceptance of these bonuses.

To satisfy the first criterion, we use messages from Commander Navy Recruiting Command (CNRC) regarding the availability of enlistment bonuses during the relevant time period. Furthermore, because sailors without a high school degree (or an equivalent qualification) were ineligible to accept enlistment bonuses, we exclude these sailors from our sample as well. To satisfy the second criterion, we exclude the following enlistment ratings and programs (listed as they appear in our data; there can be considerable overlap between the excluded ratings and programs):

- Ratings: NF, SO, EOD, ND, SB, AIRR, AECF, MT, EL6, SN, AN, FN, SS, SECF-5YO
- Programs: GTEP, SEAL, DIVR, ATF, AEF

Once these criteria[34] have been applied to our sample, the remaining sailors are eligible to accept any EBSR offered in their chosen rating.

As we have discussed, we have two variables that serve as measures of the EBSR offered to sailors in our data:

- The bonus amount prescribed by CNRC for sailors in each rating at each contracting date
- The average recorded EBSR amount for that rating under each EBSR policy period

The level of disagreement between these two measures suggests measurement error in each. First, note that we see recorded EBSR when no EBSR was prescribed for that rating. Further, prescribed EBSR and recorded EBSR are often in conflict. We interpret this as suggesting that prescribed EBSR contains measurement error. However, we also see a large degree of variation in individual recorded EBSR over time periods in which there was no change in EBSR policy. As such, we also anticipate that recorded EBSR is measured with error.

In the absence of a correction, measurement error typically leads to "attenuation bias," wherein the estimated effect of the variable measured with error is biased toward zero. A common solution to this problem when two measures of this variable (both measured with error) are available is Two-Stage Least Squares (2SLS). Here, we use recorded EBSR as the "instrument" for prescribed EBSR. To the extent that the measurement error is mean zero, is uncorrelated with the reported value, and is uncorrelated across the two measures, our 2SLS estimates will not suffer from attenuation bias.

As we state in the main part of our paper, the inclusion of Enlistment Bonus for College Credit (EBCC) further adds to the measurement error problem for college graduates. Consequently, we estimate our model separately for sailors with and without college credit.

34. We also eliminate a few sailors that exhibit data quality problems—here, sailors without college who accept EBCC or EBSO. For this analysis, we also exclude those who accept EBEE or EBLP.

As the name implies, our 2SLS estimation occurs in two stages. The purpose of the first stage is to eliminate the measurement error. To do so, we treat prescribed EBSR as a function of recorded EBSR and the other variables that we anticipate affecting whether a person accepts the enlistment bonus. Formally, our first-stage regression takes the following form:

$$\text{Prescribed EBSR}_i = c_0 + c_1 * \text{Average recorded EBSR}_i + \mathbf{b_1} * \mathbf{X_i} + u_i.$$

Here, $\mathbf{X_i}$ represents the set of variables that we anticipate affecting the probability that sailors accept an EBSR, and $\mathbf{b_1}$ represents the related vector of coefficients.

Once we have estimated this equation, we can predict the EBSR amount offered to each sailor. Ideally, use of this predicted amount will eliminate the attenuation bias that is present because of measurement error.

We also include a set of other variables that we anticipate affecting the probability that a sailor accepts a contract-lengthening EBSR. These control variables include various sociodemographic and economic variables. Our second stage regression is thus:

$$\text{EBSR is accepted}_i = a_0 + a_1 * \text{Predicted EBSR}_i + \mathbf{b_2} * \mathbf{X_i} + e_i.$$

Again, $\mathbf{X_i}$ defines our set of control variables. These variables are listed in tables 9 and 10 along with the regression results.

Table 9. Estimated effect of increasing an existing EBSR by $1,000 on contract extension (without college credit)

	Pre-2007		**Post-2007**	
	Non-technical ratings	Technical ratings	Non-technical ratings	Technical ratings
EBSR amount	0.065***	0.072***	-0.003	0.004
	(0.003)	(0.002)	(0.008)	(0.003)
White	-0.034***	-0.011*	0.005	0.015+
	(0.007)	(0.005)	(0.013)	(0.009)
Female	0.024**	0.019**	0.046**	0.041***
	(0.009)	(0.007)	(0.014)	(0.011)
Citizen	0.005	0.023+	0.052	0.104***
	(0.016)	(0.014)	(0.032)	(0.026)
AFQT	-0.004	-0.1	-0.015	0.029
	(0.091)	(0.068)	(0.182)	(0.117)
$AFQT^2$	0	0.016	0.007	-0.001
	(0.015)	(0.011)	(0.030)	(0.018)
$AFQT^3$	0	-0.001	-0.001	0
	(0.001)	(0.001)	(0.002)	(0.001)
Age	-0.413***	-0.595***	-0.702***	-1.221***
	(0.099)	(0.077)	(0.179)	(0.121)
Age^2	0.159***	0.237***	0.262***	0.476***
	(0.042)	(0.033)	(0.075)	(0.051)
Age^3	-0.020***	-0.031***	-0.032**	-0.061***
	(0.006)	(0.005)	(0.010)	(0.007)
5YO default	0.040**	0.014+	0.325***	0.100***
	(0.012)	(0.007)	(0.016)	(0.012)
Nongrad	-0.462***	-0.565***	-0.371***	-0.370***
	(0.029)	(0.017)	(0.067)	(0.041)
GED	-0.044*	-0.003	-0.088*	-0.02
	(0.018)	(0.012)	(0.037)	(0.024)
Some college	0.084***	0.087***	0.007	0.049*
	(0.015)	(0.011)	(0.032)	(0.020)
BS/B8	0	0.017	0.024	-0.033
	(0.018)	(0.014)	(0.035)	(0.025)
Associate degree	-0.008	0.032	-0.032	0.003
	(0.034)	(0.025)	(0.077)	(0.034)

Table 9. Estimated effect of increasing an existing EBSR by $1,000 on contract extension (without college credit) (continued)

	Pre-2007		Post-2007	
	Non-technical ratings	Technical ratings	Non-technical ratings	Technical ratings
Bachelor's degree	0.003	0.015	-0.089+	-0.013
	(0.026)	(0.021)	(0.054)	(0.032)
Other educational credential	-0.006	-0.032	-0.029	-0.029
	(0.040)	(0.031)	(0.079)	(0.051)
S&P 500 closing price	-0.015**	-0.005	0.063***	0.024***
	(0.005)	(0.004)	(0.009)	(0.004)
State unemployment rate	-0.011**	0.006+	-0.014*	-0.019***
	(0.004)	(0.003)	(0.007)	(0.004)
State new unemployment claims	-0.012+	-0.062***	-0.001	0.008
	(0.007)	(0.005)	(0.012)	(0.007)
Federal funds rate	-0.015	-0.084+	-0.143	-0.334***
	(0.060)	(0.049)	(0.146)	(0.085)
Expected business conditions (5 years)	0.006***	0.006***	-0.003*	-0.002***
	(0.001)	0.000	(0.001)	(0.001)
Constant	3.742***	4.986***	6.059***	10.582***
	(0.797)	(0.614)	(1.446)	(0.978)
N	13,068	30,940	5,007	12,777

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 10. Estimated effect of increasing an existing EBSR by $1,000 on contract extension (with college credit)

	Pre-2007		Post-2007	
	Non-technical ratings	Technical ratings	Non-technical ratings	Technical ratings
EBSR amount	0.053***	0.041***	0.025**	0.019*
	(0.005)	(0.004)	(0.009)	(0.008)
White	-0.004	0.005	0.009	-0.030+
	(0.011)	(0.009)	(0.021)	(0.018)
Female	0.011	0.014	-0.021	-0.001
	(0.012)	(0.010)	(0.023)	(0.020)
Citizen	0.014	0.006	-0.066+	0.001
	(0.019)	(0.016)	(0.034)	(0.031)
AFQT	-0.067	-0.072	0.222	-0.229
	(0.127)	(0.117)	(0.246)	(0.239)
AFQT2	0.007	0.012	-0.034	0.043
	(0.020)	(0.018)	(0.040)	(0.036)
AFQT3	-0.0002	-0.0007	0.0015	-0.0024
	(0.0010)	(0.0009)	(0.0021)	(0.0018)
Age	0.122	0.156	0.638**	-0.129
	(0.126)	(0.105)	(0.247)	(0.221)
Age2	-0.048	-0.061	-0.254**	0.057
	(0.050)	(0.042)	(0.098)	(0.088)
Age3	0.006	0.008	0.033**	-0.008
	(0.007)	(0.006)	(0.013)	(0.012)
5YO default	0.027	-0.021+	0.305***	0.005
	(0.018)	(0.011)	(0.029)	(0.020)
Some college	0.026	0.047**	-0.061	-0.035
	(0.023)	(0.018)	(0.046)	(0.034)
BS/B8	-0.320***	-0.244***	-0.376***	-0.316***
	(0.026)	(0.021)	(0.052)	(0.040)
Associate degree	0.120***	0.082***	0.122*	0.029
	(0.028)	(0.023)	(0.056)	(0.038)
S&P 500 closing price	-0.013+	0.012+	0.038**	0.045***
	(0.008)	(0.006)	(0.013)	(0.009)

Table 10. Estimated effect of increasing an existing EBSR by $1,000 on contract extension (with college credit) (continued)

	Pre-2007		Post-2007	
	Non-technical ratings	Technical ratings	Non-technical ratings	Technical ratings
State unemployment rate	0.004	-0.012*	-0.019+	-0.026***
	(0.006)	(0.005)	(0.011)	(0.007)
State new unemployment claims	-0.022*	-0.004	-0.012	-0.002
	(0.010)	(0.008)	(0.017)	(0.014)
Federal funds rate	-0.076	-0.450***	0.01	-0.412*
	(0.090)	(0.077)	(0.219)	(0.176)
Expected business conditions (5 years)	0.001	0	-0.004*	-0.003*
	(0.001)	(0.001)	(0.002)	(0.001)
Constant	-0.226	-0.554	-5.207*	1.755
	(1.084)	(0.906)	(2.093)	(1.891)
N	4,712	7,348	1,662	2,726

The skill-channeling effect of enlistment bonuses

As we describe in the main text, we calculate (by month) the percentage of each rating's contracts that fall into each of four mutually exclusive quality groups: non-A-cell, A-cell, technical quality, and high quality. We also calculate the average monthly EBSR offered in each rating, in similar ratings, and in dissimilar ratings.[35] Table 11 shows the results for our variables of interest; here, we formally define the empirical model and record the full results of our regressions.

35. Here, "similar" and "dissimilar" ratings are based on whether a rating shares the technical/nontechnical designation of the rating in question.

Table 11. How does EBSR affect percent skill type in ratings?

	Non A-cell	A-cell	Technical Quality	High Quality
EBSR offered	-0.013*	-0.007	0.009**	0.011*
	(0.005)	(0.004)	(0.003)	(0.004)
EBSR offered in similar ratings	0.020*	0.003	-0.011**	-0.012**
	(0.009)	(0.007)	(0.004)	(0.004)
EBSR offered in dissimilar ratings	-0.005	0.007	-0.001	-0.002
	(0.009)	(0.005)	(0.003)	(0.003)
Technical rating	-0.249***	0.012	0.123***	0.114***
	(0.064)	(0.034)	(0.029)	(0.030)
State unemployment rate	-0.022	0.026**	-0.001	-0.003
	(0.015)	(0.009)	(0.007)	(0.005)
S&P 500 closing price	-0.01	0.009+	0.003	-0.001
	(0.006)	(0.005)	(0.004)	(0.003)
Expected business conditions (5 years)	-0.011	0.003	0.004	0.004
	(0.007)	(0.004)	(0.004)	(0.004)
E-3 pay	-0.034+	-0.01	0.021**	0.023**
	(0.017)	(0.013)	(0.008)	(0.007)
Federal funds rate	0.008	0.003	-0.004	-0.008
	(0.014)	(0.006)	(0.007)	(0.005)
Index of consumer sentiment	0.006	-0.006	-0.002	0.002
	(0.014)	(0.008)	(0.007)	(0.005)
Initial UI claims	0.006	0.006	-0.003	-0.009
	(0.017)	(0.012)	(0.009)	(0.008)
February	-0.002	0.001	0.002	-0.001
	(0.011)	(0.007)	(0.006)	(0.004)
March	0.003	-0.004	-0.001	0.002
	(0.010)	(0.006)	(0.005)	(0.005)
April	-0.01	-0.009	0.008	0.010+
	(0.015)	(0.009)	(0.006)	(0.006)
May	0.012	-0.018+	-0.005	0.011+
	(0.015)	(0.009)	(0.007)	(0.006)
June	0.014	-0.008	-0.001	-0.005
	(0.012)	(0.008)	(0.007)	(0.005)
July	0.009	-0.006	0.003	-0.005
	(0.013)	(0.009)	(0.007)	(0.005)
August	0.008	-0.01	0.003	-0.002
	(0.016)	(0.010)	(0.006)	(0.006)
September	0.033*	-0.015	-0.006	-0.012*
	(0.016)	(0.011)	(0.007)	(0.006)

Table 11. How does EBSR affect percent skill type in ratings? (continued)

	Non A-cell	A-cell	Technical Quality	High Quality
October	0.015	-0.018+	0.004	-0.002
	(0.018)	(0.010)	(0.007)	(0.007)
November	0.001	0.002	-0.001	-0.003
	(0.016)	(0.009)	(0.007)	(0.006)
December	0.006	-0.001	-0.003	-0.002
	(0.013)	(0.010)	(0.006)	(0.005)
2003	-0.029	0.018	0.006	0.005
	(0.021)	(0.014)	(0.010)	(0.008)
2004	0.017	0.028*	-0.022+	-0.023*
	(0.024)	(0.014)	(0.011)	(0.011)
2005	-0.003	0.045**	-0.019	-0.022*
	(0.024)	(0.015)	(0.013)	(0.010)
2006	0.029	0.028+	-0.032+	-0.024*
	(0.025)	(0.015)	(0.017)	(0.012)
2007	0.055*	0.018	-0.039*	-0.034**
	(0.025)	(0.017)	(0.017)	(0.012)
2008	0.057*	0.036*	-0.048**	-0.045***
	(0.024)	(0.015)	(0.016)	(0.013)
2009	0.033	0.02	-0.024+	-0.029*
	(0.023)	(0.019)	(0.014)	(0.013)
Constant	1.282***	0.16	-0.212+	-0.231*
	(0.281)	(0.191)	(0.116)	(0.108)
N	5,721	5,721	5,721	5,721

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

While a fixed-effects panel data regression may seem ideal for our analysis, we instead use monthly averages as a repeated cross-section. We do so because of the importance for time-varying weights in our analysis: intuitively, it would seem that months that record the quality composition of 20 new contracts in a specific rating should be given more weight than months that record 1 new contract in that rating. Further, by using time-specific rating weights, we avoid the need to specify a percentage for 0 out of 0 contracts (with time-varying weights, the specification is irrelevant because the observation gets a regression weight of 0).

Our empirical model for each quality type, then, is:

$$\%\ \text{Quality}_i = a_0 + a_1 * \text{EBSR in rating}_i + a_2 * \text{EBSR in similar ratings}_i + a_3 * \text{EBSR in dissimilar ratings}_i + \mathbf{b} * \mathbf{X_i} + e_i.$$

Here, **b** is a vector of coefficients on variables $\mathbf{X_i}$, which indicate month and year effects as well as economic variables for that month (or quarter/year if monthly variables are unavailable).

Table 11 shows the results of these regressions and includes a full list of control variables.

The impact of an obligation-lengthening bonus on attrition

Our discussion of the effect of EBEE on attrition in the main text pays particular attention to the difference-in-difference (DD) model. Here, we slightly expand this discussion and display the full results of our analysis.

Recall that the main problem of looking at a difference in means in solely the affected ratings is that this difference will also capture effects unrelated to the event of interest—here, the introduction of EBEE. For instance, if the average civilian economic conditions are different between 2004 and 2006 than other times in a way that affects 45-month attrition, this change that is actually due to economic conditions will be falsely attributed to EBEE.

DD instead compares the change in means in the affected ratings to the change in unaffected, or control, ratings. Mathematically, we can represent DD as the following, where $\bar{a}$ and $\bar{c}$ represent the average attrition (conditional on sailor and rating characteristics) of EBEE ratings and control group ratings, respectively:

$$DD\ effect = \underbrace{(\bar{a}_{EBEE\ in\ effect} - \bar{a}_{EBEE\ not\ in\ effect})}_{\substack{\text{Change for EBEE ratings} \\ \text{(Difference in means)}}} - \underbrace{(\bar{c}_{EBEE\ in\ effect} - \bar{c}_{EBEE\ not\ in\ effect})}_{\substack{\text{Change for “control” ratings} \\ \text{(Change that would have happened anyway)}}}$$

Our empirical model, then, follows the traditional DD model:

$$\text{Attrite}_i = a_0 + a_1 * \text{EBEE rating}_i * \text{EBEE in effect}_i + a_2 * \text{EBEE rating}_i + a_3 * \text{EBEE in effect}_i + \mathbf{b} * \mathbf{X_i} + e_i.$$

Here, a_1 is the coefficient of interest. That is, a_1 measures the effect of offering EBEE on attrition. Following previous notation, **b** is a vector of coefficients for the set of control variables represented by $\mathbf{X_i}$.

We estimate this model twice: once with each control group (other technical ratings and nontechnical ratings). These estimates are shown in table 12, which also serves to list the set of control variables.

Note here that we include accepted EBSR and EBCC as control variables. However, we do not interpret either of these variables as the attrition effect of an offered bonus. The reason for this is simple: because we have not controlled for other factors that might affect whether an EBSR or EBCC is offered (such as a robust civilian job market) that might also affect attrition, these estimates are correlations, not causal estimates.

Table 12. The effect of the availability of EBEE on first-term attrition

	Control group: other technical ratings	Control group: nontechnical ratings
DD effect	0.007	0.019*
	(0.009)	(0.009)
EBEE time period	0.001	-0.003
	(0.006)	(0.005)
EBEE-eligible ratings	0.012+	-0.047***
	(0.007)	(0.007)
Received EBSR	0.018*	0.049***
	(0.008)	(0.007)
EBSR amount	0.003*	-0.009***
	(0.002)	(0.002)
Received EBCC	-0.028*	-0.019
	(0.013)	(0.013)
EBCC amount	-0.004	-0.006+
	(0.003)	(0.003)
A-cell	-0.013	0.00004
	(0.009)	(0.007)
Technical quality	0.005	-0.009
	(0.008)	(0.009)
High quality	0.006	0.004
	(0.009)	(0.012)
State unemployment rate	-0.005*	-0.005*
	(0.002)	(0.002)
S&P 500 closing price	0.002	0.005
	(0.004)	(0.004)
Expected business conditions (5 years)	0.001	0.00009
	(0.001)	(0.0005)
E-3 pay	-0.013	-0.012
	(0.011)	(0.010)
AFQT	0.003	0.006
	(0.006)	(0.005)
$AFQT^2$	-0.0005	-0.001
	(0.0009)	(0.001)
$AFQT^3$	0.00002	0.00006
	(0.00005)	(0.00004)

Table 12. The effect of the availability of EBEE on first-term attrition (continued)

	Control group: other technical ratings	Control group: nontechnical ratings
Age	0.108*	0.160**
	(0.055)	(0.049)
Age^2	-0.047*	-0.066**
	(0.023)	(0.021)
Age^3	0.007*	0.009**
	(0.003)	(0.003)
Federal funds rate	0.005	0.001
	(0.004)	(0.004)
Index of consumer sentiment	-0.001	-0.0005
	(0.001)	(0.0008)
State new unemployment claims	0.0001	0.009
	(0.014)	(0.012)
Nongrad	0.125***	0.110***
	(0.016)	(0.016)
GED	0.121***	0.135***
	(0.014)	(0.012)
Some college	-0.018	-0.031*
	(0.015)	(0.015)
BS/B8	0.114***	0.130***
	(0.014)	(0.013)
Associate degree	-0.057*	-0.022
	(0.023)	(0.024)
Bachelor's degree	-0.001	-0.018
	(0.025)	(0.024)
Other educational credential	0.133***	0.134***
	(0.024)	(0.019)
Citizen	0.144***	0.163***
	(0.009)	(0.007)
Female	0.066***	0.055***
	(0.005)	(0.004)
Constant	-0.555	-0.999*
	(0.471)	(0.420)
N	61,520	77,217

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

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Glossary

AFQT	Armed Forces Qualifying Test
ASVAB	Armed Services Vocational Aptitude Battery
BMI	Body Mass Index
CNRC	Commander Navy Recruiting Command
CTT	Cryptographic Technician (Technical)
DD	Difference-in-Difference
DEP	Delayed Entry Program
DMDC	Defense Manpower Data Center
DOD	Department of Defense
EAOS	End of Active Obligated Service
EB	Enlistment Bonus
EBCC	Enlistment Bonus for College Credit
EBEE	Enlistment Bonus for Extended Enlistment
EBLP	Enlistment Bonus for Language Proficiency
EBSO	Enlistment Bonus for Special Operations
EBSR	Source Rating Enlistment Bonus
FMAM	February, March, April, and May
HT	Hull Maintenance Technician
IC	Interior Communications Electrician
IT	Information Systems Technician
LOS	Length of Service
MEPCOM	Military Entrance Processing Command
MEPS	Military Entrance Processing Station

NBER	National Bureau of Economic Research
OLS	Ordinary Least Squares
OPI	Oral Proficiency Interview
OSD	Office of the Secretary of Defense
PRIDE	Personalized Recruiting for Immediate and Delayed Enlistment
PST	Prescribed Sea Tour
STG	Sonar Technician (Surface)
UI	Unemployment Insurance
YO	Years of Obligation
2SLS	Two-Stage Least Squares

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