Recruiting in the 21st Century: Technical Aptitude and the Navy's Requirements

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Executive summary

The Navy has an increasing need to find recruits with technical aptitude. Three main developments are motivating this demand:

1. Advances in science and technology have caused the Navy's weapon systems to become more complex. For this reason, Navy personnel must be technically proficient to adequately operate and maintain these advanced systems.
2. The increasing use of more efficient, software-based technology means that people with information technology experience are needed for development and implementation of these software systems.
3. The success of network-centric warfare depends largely on warfighters using technology to collect and analyze complex information and then using this information to make critical decisions.

For all these reasons, technology is an important aspect of today's Navy. Identifying and attracting people with technical aptitude and placing them in ratings that use their skills are key components of maintaining a high-quality Navy.

As the technical requirements in the Navy have grown over the past decade, many other elements of the recruiting environment have changed as well. Deployments have increased as part of the war on terror, the civilian unemployment rate has varied dramatically, college costs have increased steadily, and civilian wages stagnated. At the same time, the Navy recruits far fewer new Sailors per year now than in the past.

This paper takes into account the Navy's need for technical skills and the current economic climate, and it looks at the interaction between the military and civilian labor markets from the late 1990s to the present. In contrast to many other authors, we include data on both applicants and accessions; this allows us to follow the path of the most qualified applicants into the Navy. We use both state- and individual-level models. Our state-level supply models allow us to examine patterns in recruit production, while the individual-level models are better suited to measure the effects of civilian factors versus personal characteristics.

We focus on highly qualified applicants with technical aptitude, both because of the Navy's increasing needs for technical skills and because this population receives the majority of bonus recruiting dollars. Finally, this population may be more sensitive than other recruits to civilian conditions (perhaps because the most highly qualified recruits have many opportunities).

Along with the traditional definition of "high quality" recruits, we develop and test several more stringent definitions that are likely to become increasingly relevant as the Navy continues to recruit those who have substantial technical aptitude. Regardless of definition, we find that the quality of Navy accessions has increased substantially over the past decade.

We also trace the paths of new recruits to determine who is promised, and who eventually serves in, a technical rating. "Job match," measured by the probability of serving in a type of rating that was initially promised, has improved over time. Of course, many recruits still fail to complete the most technical training offered by the Navy, but recruits with technical aptitude are more likely to be promised and to enter technical ratings than in the past. This could be attributable to several factors; changes in enlistment bonuses are an example. Consistent with the Navy's increasing use of technology, the proportion of Sailors promised and serving in technical ratings has increased substantially over the last decade. This growth comes from the nonnuclear technical ratings.

However, there remains considerable "excess capacity"; a substantial proportion of recruits with technical aptitude do *not* serve in technical ratings. It is surely optimal to have Sailors with technical aptitude spread throughout the fleet, but we also find that those with technical aptitude who are *not* promised a technical rating have much higher attrition than similar Sailors who are promised and serve in technical ratings. A thorough exploration of this relationship is beyond the scope of this research, but this does suggest that overall performance could improve if Sailors with technical aptitude were more likely to serve in technical ratings. Further understanding of this process is likely to become especially important when the recruiting climate begins to deteriorate.

Because of their civilian opportunities, it is possible that the most highly qualified applicants or Sailors respond differently than other Sailors to economic incentives. One could imagine that highly qualified Sailors would be more, or less, sensitive than other Sailors to civilian labor market conditions. We find that the most qualified recruits are somewhat less influenced by the unemployment rate than others, although they may be slightly more sensitive to postsecondary tuition rates. These effects are small, however; our individual-level models indicate that economic factors are dwarfed by a person's own education level and age, especially in the case of highly qualified applicants.

Because recruiting resources are allocated based on A-cell requirements, we are also interested in determining whether the most highly qualified recruits come from the same areas as other A-cells.[1] Some areas seem to be particularly good sources of the most qualified Sailors, even holding constant differences in population and education. But population remains the determining factor; other differences are comparably small. In general, our results suggest that highly qualified Sailors can be found in many of the same areas as other Sailors. Our results from the individual-level models suggest that the most qualified applicants differ from other applicants in terms of age and education, which suggests that, regardless of region, many highly qualified applicants are unlikely to meet recruiters in the most traditional surroundings.

1. "A-cell" recruits are those who score at least 50 on the Armed Forces Qualification Test (AFQT) *and* hold a high school diploma or equivalent credential; these recruits are sometimes referred to simply as "high quality."

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Introduction and background[2]

Each year, 35,000 to 50,000 new recruits enter the Navy. Over the last 10 to 12 years, the recruiting environment has varied widely. During the late 1990s, all the Services struggled to recruit qualified applicants as civilian wages rose and unemployment rates reached nearly unprecedented lows. (By 2000, the civilian unemployment rate had dropped below 4 percent—a level not seen since the late 1960s.) In the post-9/11 era, the Navy has recruited highly qualified applicants each year; current quality levels are very high compared with historic measures. In 2006, however, civilian unemployment rates again began to fall, causing concern among military planners. Unemployment rates began to increase again in the fall of 2008. After the collapse of the financial sector, unemployment spiked to rates not seen since the early 1980s. Through these changes, Navy recruiters have maintained a focus on finding recruits who can acquire the skills necessary to carry out the Navy's mission.

Specifically, the Navy has an increasing need to find recruits with technical aptitude. Three main developments motivate this demand:

1. Advances in science and technology have caused the Navy's weapon systems to become more complex. For this reason, Navy personnel must be technically proficient to adequately operate and maintain these advanced systems.

2. The increasing use of more efficient, software-based technology means that people with information technology experience are needed for development and implementation of these software systems.

3. The success of network-centric warfare depends largely on warfighters using technology to collect and analyze complex

2. This paper benefited enormously from the comments and suggestions of Dr. Edward Schmitz and Dr. Christopher Jehn.

information and then using this information to make critical decisions (e.g., see [1], [2], and [3]).

For all these reasons, technology is an important aspect of today's Navy force. Therefore, it is important to ensure that the Navy is prioritizing the recruitment of those who are capable of acquiring and carrying out these important technical skills.

Current research

This paper is part of a larger research project that first examined technical recruits in general. We looked at the factors that are predictive of successful technical recruits in the Navy, providing the Navy with useful information to help in allocating recruiting resources. Earlier tasks in this project traced the importance of technical aptitude and skills in the Navy, explored civilian efforts to recruit those with technical aptitude, and explored the relationship between technical aptitude and performance.

Our findings from these tasks suggest that the Navy requires recruits with technical aptitude for several specific areas of work, including aircraft maintenance, ship design, serving on submarines, and formulating information technology policy. While leadership in these areas will be provided by Navy officers, all available literature suggests that the need for enlistees with technical aptitude and skills will grow in the future.

Technical aptitude and skills are also quite desirable in many civilian fields; civilian companies recruit workers for technical aptitude via partnerships with academic institutions, various types of social networking, and demonstrations or competitions. These avenues provide suggestions for the Navy to expand recruiting beyond the current model.

Our initial analysis of those serving in technical ratings indicated that educational category has a greater influence than AFQT score on attrition; among those who qualify for technical ratings, AFQT has little additional influence on attrition. This is consistent with much of the previous literature. In contrast, we found that AFQT is more important in explaining attrition for those in nontechnical ratings, although here too education also has a substantial influence [4].

Based on these initial findings, in this paper we test several definitions of technical aptitude and focus on the relationship between these definitions, rating promised, rating achieved, and performance. Specifically, we focus on a subset of all applicants—those with the strongest test scores and education credentials. These applicants are qualified for the most technical and specialized Navy ratings. We are interested in tracing the path of these applicants through the application process and into the Navy.

This methodology also affords us the opportunity to measure the Navy's increasing need for technical skills and aptitude by focusing on a subset of ratings requiring above-average aptitude. But even beyond this, we have at least two other reasons for focusing on these highly qualified applicants:

- Highly qualified enlistees in a few technical ratings receive the majority of bonus dollars.
- Highly qualified applicants/enlistees are likely to have good civilian opportunities and, thus, may be more sensitive to civilian economic conditions than others.

Therefore, we look extensively at economic conditions, examining the interaction between the military and civilian labor markets from the late 1990s to the present, and how this can affect the population that the Navy needs the most. It is possible that a change in the number of highly qualified applicants may serve as an "early warning system" for coming changes in the recruiting market. Another possibility is that highly qualified applicants may be more or less likely to serve in technical ratings (with their longer obligations) based on economic conditions. In addition, recruiting resources are allocated based on A-cell requirements; thus, the Navy implicitly assumes that the most highly qualified recruits come from the same areas as other A-cells.[3] If, in fact, the highest quality recruits are produced via a

3. A-cell, or high-quality, recruits are those who score at least 50 on the AFQT *and* hold a high school diploma or equivalent credential.

different process, understanding this process could lead to a more efficient allocation of resources. Finally, as recruiting conditions change, the proportion of highly qualified applicants is likely to change, probably more quickly than the Navy's requirements. Thus, we would like to understand the extent to which highly qualified applicants serve in technical ratings.

Scope of research

To summarize, we explore four questions in this paper:

- How has the quality of Navy applicants and accessions changed over time?
- To what extent do highly qualified recruits serve in ratings that make use of their backgrounds?
- Do highly qualified recruits respond to economic and educational incentives in different ways from other recruits?
- Do highly qualified recruits come from the same areas as other A-cell recruits? (That is, are highly qualified recruits "produced" in the same manner as other A-cell recruits?)

Who is highly qualified?

Because there is no standard definition of a *highly qualified* applicant, we use and compare several definitions. Past research has focused on A-cell recruits (e.g., see [5] or [6]), who are often referred to as high-quality recruits. The past focus on education credentials and A-cell recruits in particular is understandable because education credentials are a strong, reliable predictor of military performance (e.g., see [7] through [11]). Education credentials are thought to specifically measure "adaptability," whereas the AFQT is thought to measure "trainability." Recruits require both types of skills to succeed in the military. In the current recruiting environment, however, the large majority of recruits are A-cells (nearly 70 percent in FY08), while the most technical ratings have considerably more stringent requirements. Therefore, in addition to A-cell, we use and test two more stringent definitions of highly qualified:

- High school diploma (or other Tier 1 education credential) **and** AFQT score of 67 or better. (We refer to these applicants as *tech qualified.)*
- High school diploma (or other Tier 1 education credential) **and** Armed Services Vocational Aptitude Battery (ASVAB) subscore total of 240 or better.[4] (We refer to these applicants as *nuke qualified.)*

Different ratings have different specific qualifications, usually made up of combinations of ASVAB subtest scores. Because the nuclear field has far more stringent requirements than other fields, we consider nuke qualification separately. However, we also need a less stringent requirement that captures the likelihood of qualifying for a (nonnuclear) technical rating. Even though each rating has different specific requirements, applicants who score at least 67 on the AFQT usually are qualified for a large number of technical ratings (e.g., AECF, CTT, and STG). Therefore, we use the combination of a score of 67 or more on the AFQT and possession of a Tier 1 credential to define tech qualified.

Which factors have been found to predict attrition?

Most studies focus on first-term attrition (i.e., failure to complete the term of service) as a primary performance measure. On average, those who complete a traditional high school curriculum have lower

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4. Nuclear field qualification depends on ASVAB subscores. Applicants qualify through one of several routes:

   - a combined score of 252 on the following four sections of the ASVAB—arithmetic reasoning (AR), mathematics knowledge (MK), electronics information, and general science;
   - a combined score of 252 on the AR, MK, mechanical comprehension, and verbal expression sections of the ASVAB;
   - a score of 240 on either of the above combinations as well as a score of 50 on the Navy Advanced Programs Test (NAPT).

   We do not have scores on the NAPT; therefore, we use a subscore of 240 on either combination above, understanding that this measure will slightly overstate the number who qualify.

attrition than those who attain an alternate credential.[5] A-cell recruits also perform better than other recruits. Research suggests that AFQT scores have a positive but small correlation with performance; those with higher AFQT scores are slightly less likely to attrite (e.g., see [11]). Most research, however, includes AFQT score as a control variable, often assuming that the relationship between AFQT and performance is linear. This is unlikely to be the case. To the extent that AFQT measures trainability, the effect of increasing one's score from 65 to 75, for example, is likely to improve the ability to understand training, but it is not clear that increasing a score from 85 to 95 would have the same effect. Reference [12] found that those with higher AFQT scores had lower attrition; in addition, their results suggest a nonlinear effect of AFQT on attrition. Our earlier research found that AFQT score had relatively little influence on performance of those in technical ratings, most of whom possess relatively high scores.

Research also suggests that recruits, especially A-cell recruits, are responsive both to the Navy's incentives and to civilian economic conditions [5]. In particular, high-quality (A-cell) recruits respond to civilian-military pay ratios and to civilian unemployment rates. Across the Services, a 10-percent decline in unemployment results in a 2- to 3.5-percent decrease in high-quality accessions [5].

Methodology

In this work, we employ several methodologies to explore our research questions. First, we combine data on applicants with accession data. This allows us to trace the path that applicants follow as they enter the Navy. (Most research focuses on accessions; while such a focus is appropriate to answer many questions, it misses crucial early steps of the accession process.) We present detailed statistics from these data sources in the following section. Second, we use different models in different sections of the analysis. To determine the areas

5. Alternate credentials include General Education Development (GED) and adult education certificates, some hours of community college, an occupational certificate, a homeschooling diploma, and completion of the ChalleNGe program.

that produce the most recruits and the most qualified recruits, we use accession data aggregated to the state level. These data allow us to determine the effects of civilian factors on the overall supply of recruits. This model is similar to recruit supply models used by numerous other researchers and provides results that can be compared with earlier findings. To determine the factors that affect a person's decision to sign a contract, we use a different model with individual-level data on accessions and applicants. We present results from both of these models in the results section.

Next, we discuss our data sources and present descriptive statistics. The third section includes our main results. In the final section, we present our conclusions.

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Data and descriptive statistics

Data sources

This research utilizes several data sources. We use CNA's Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE) files to form a dataset of all who enlisted in the Navy between 1999 and 2009. Only those who sign a contract and enter the Navy appear in PRIDE; those who fail to qualify or who qualify but choose not to enlist do not. The only source of information about the latter group is the Military Enlistment Processing Command (MEPCOM) files, kept by the Defense Manpower Data Center (DMDC). To form a dataset of applicants, we requested and received data on all who travel to a Military Entrance Processing Station (MEPS) with the intention of enlisting in the Navy for the 1998–2009 period.[6]

We supplement our military data with various measures of the civilian economy and demographics from the Current Population Series and Census data. We discuss each civilian measure in more detail in appendix A.

In addition to indicating how many Sailors access into the Navy, PRIDE files contain information on each Sailor's rating. Therefore, the PRIDE files allow us to see how many of the Sailors who qualify for technical ratings actually enter those ratings. This measure is likely to vary with economic conditions. Using these data, we first document trends over the period of interest. These descriptive statistics follow immediately; we present results in the next main section.

6. We wish to thank Richard Moreno and Marisa Michaels of DMDC for providing the MEPCOM applicant files. We thank David Gregory and David Reese of CNA for providing the PRIDE file.

Trends in applicants and accessions

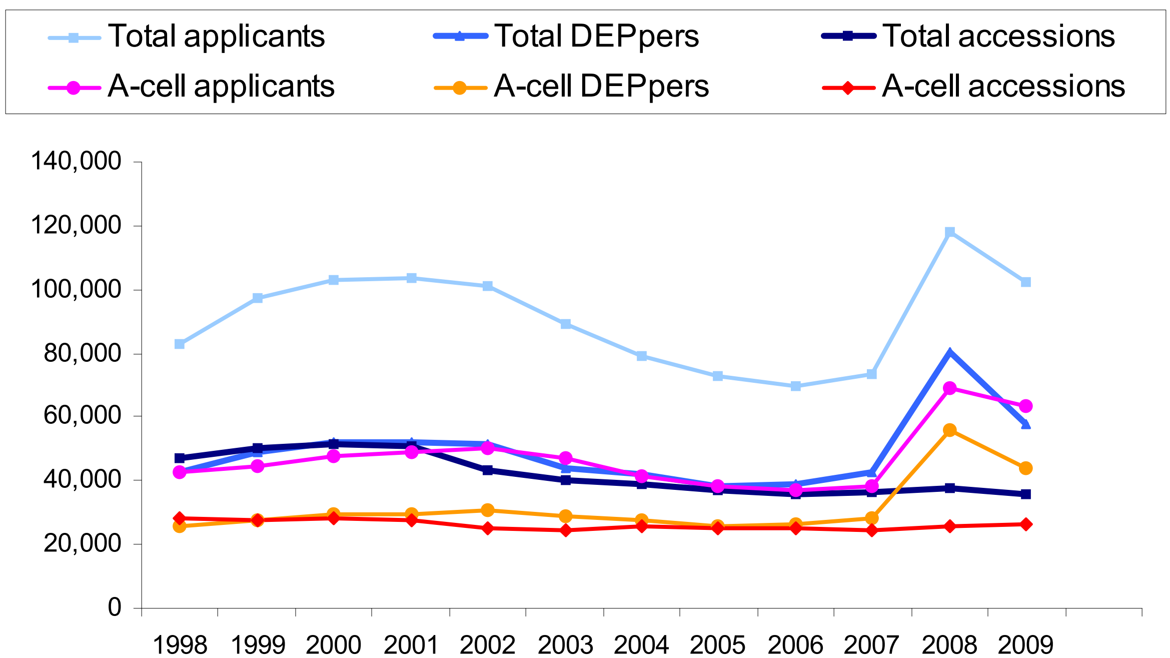
In this subsection, we present descriptive statistics using both the MEPCOM and the PRIDE files. We focus on measures of quality and the likelihood that the most qualified potential Sailors enlist. Our MEPCOM files include information on 1.1 million people who intended to enlist in the Navy during FY98 through FY09. We begin by describing general trends in the number of applicants and accessions, as well as trends in the most highly qualified applicants and accessions. In the next subsection, we focus on high-tech ratings, both promised and achieved. Finally, we describe the civilian economy during the period covered by our data and include some descriptive statistics on differences across states and Census divisions.

An important step between the MEPS and bootcamp is the Delayed Entry Program (DEP); most Sailors enter DEP for at least a short time after signing a contract. Sailors may spend as much as a year in DEP, although most spend only a few months in this status. In particular, those who are in the process of completing high school often enter DEP for several months while still in school; they ship to bootcamp during the summer after graduation. However, a substantial number of recruits—about 23 percent during recent years [6]—attrite while in DEP. Finally, the size of the DEP pool fluctuates throughout the year and generally increases as recruiting becomes easier.

Because of the time spent in DEP, it is *not* appropriate to assume that MEPCOM and PRIDE files from the same years include exactly the same people. It would be typical for recruits to appear in MEPCOM files in one fiscal year, spend time in DEP, and appear in the Navy the following fiscal year. Thus, our descriptive statistics for a given year indicate the number of applicants who entered MEPS during the year, the number who entered DEP, and, finally, the number who accessed into the Navy during that year, but each includes a somewhat different group of Sailors. It is insightful, however, to compare the three data sources to follow the "flow" of applicants.

We begin our analysis by comparing the sizes of our three samples: (1) all who enter the MEPS with the intention to enlist ("applicants"), (2) all who sign a contract and enter DEP ("DEPpers"), and (3) all who ship to bootcamp ("accessions" or "enlistees"). The number of (potential) Sailors decreases with each step. As figure 1 shows, the number of recruits who entered DEP each year is smaller than the number of applicants; the number of eventual accessions is smaller yet due to attrition from DEP. While the total number of A-cell applicants also exceeds the total number of A-cell accessions, figure 1 indicates that A-cell applicants are much more likely than other applicants to access into the Navy.

Figure 1. Applicants and accessions, by quality and year[a]



a. Applicant numbers from MEPCOM files; accession numbers from CNA PRIDE files; all years indicate fiscal year.

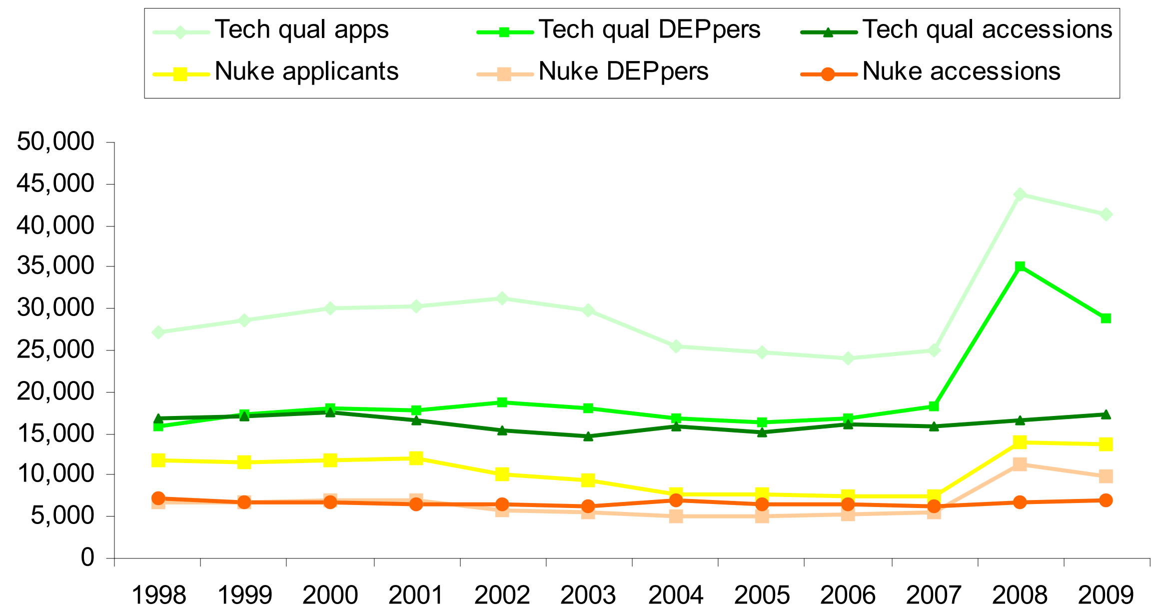
In this research, we do not attempt to determine *why* some applicants enter the Navy while others do not. Other research indicates that a large proportion of applicants are ineligible to serve because of their education credentials, AFQT score, weight, family situation, or other factors [13]. A-cell applicants, by definition, meet the education and AFQT requirements; however, these applicants may have other barriers to service, second thoughts about signing a contract, or hesitations to enlist in the ratings available.

Figure 1 indicates that the total number of applicants rose between 1998 and 2000, began to fall in 2001, and fell steadily until 2006. In 2008, the number of applicants rose very sharply, as a result of changes in the civilian economy as well as use of substantial Navy recruiting resources. A-cell applicants follow a similar pattern. A shrinking recruiting mission caused the number of accessions to fall over this period; the DEP pool, however, increased dramatically during these years with the average Sailor spending more time in DEP. While additional time in DEP results in an increase in DEP attrition, it also results in a substantial increase in performance (in terms of both in-service attrition and promotion) [6].

In figure 2, we begin to focus on the most qualified applicants, DEPpers, and accessions. Among tech-qualified applicants, the pattern is very much like that of all applicants and A-cell applicants—a decrease in 2003 to 2004 and a sharp increase at the end of the period. Among nuke-qualified applicants, the total change over the time period is smaller, although again there is an increase in 2008. Figure 2 also indicates that a large proportion of nuke-qualified applicants enter DEP and that nearly all who enter DEP access. (Again, the uptick in applicants and DEPpers in 2008 and 2009 represents an increase in the size of the DEP pool and the months spent in DEP.) Finally, figure 2 shows that, as the recruiting climate and the accession mission have changed, the numbers of nuke-qualified applicants and accessions have remained constant. The numbers of tech-qualified applicants and accessions have varied more but not as widely as the total numbers of applicants or accessions (see figure 1). Given today's relatively small recruiting missions, this suggests that the quality of recruits has increased, and that the Navy is effective in obtaining commitments from the majority of tech-qualified applicants and the large majority of nuke-qualified applicants. (We model this process more explicitly in the next section.)

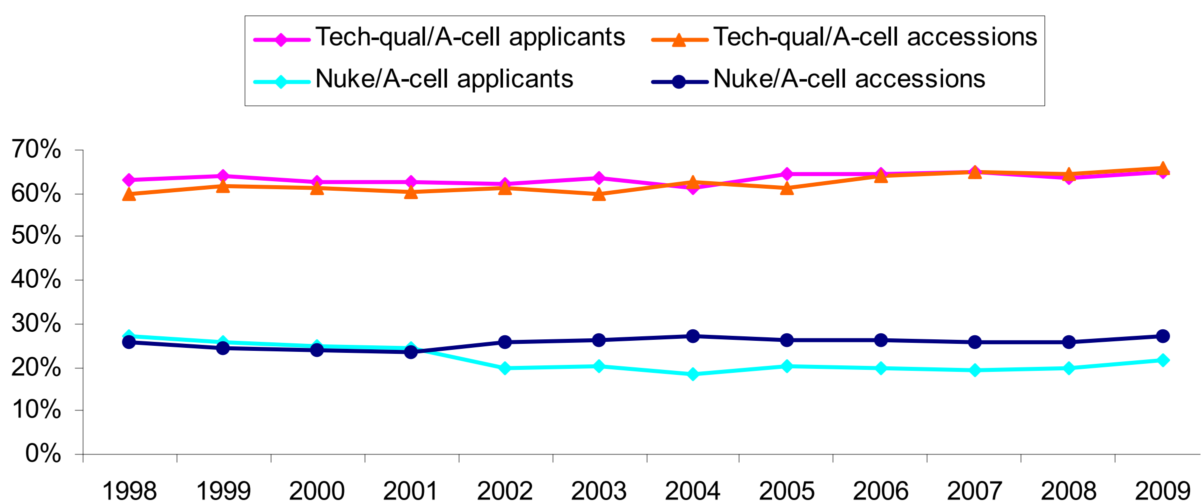
Continuing to focus on the most qualified applicants, figure 3 includes only A-cell applicants and accessions. Figure 3 presents the proportions of A-cell applicants and accessions who are tech qualified or nuke qualified. Even as the proportions of A-cell applicants and accessions have increased, the data indicate slight upward trends, especially in the proportion of A-cell accessions who are highly qualified. Figures 1 through 3 indicate that the quality of new Sailors increased over this time period.

Figure 2. Number of applicants and number of highly qualified applicants by FY[a]



a. Applicant numbers from MEPCOM files; accession numbers from CNA PRIDE files; all years indicate fiscal year.

Figure 3. Ratio of highly qualified applicants and accessions, by fiscal year[a]



a. Applicant numbers from MEPCOM files; accession numbers from CNA PRIDE files; all years indicate fiscal year.

To summarize, as the Navy's mission decreased during the early years of this century, the number of highly qualified accessions stayed relatively steady (regardless of definition). Thus, the *proportion* of highly qualified accessions increased during this period. Indeed, by FY09, 74 percent of accessions were A-cells, 49 percent were tech qualified, and nearly 20 percent were nuke qualified. In each case, this represents a substantive increase in the quality measure compared with a decade prior. Thus, in 2009 the Navy accessed about 30 percent fewer Sailors than in 1999 or 2000, but it accessed nearly as many A-cell Sailors, more tech-qualified Sailors, and about as many nuke-qualified Sailors. As part of this research, we will attempt to determine the role that the eroding civilian economy played in these trends.[7]

The preceding figures indicate an increase in the quality of accessions, but they don't measure the proportion of qualified Sailors who *serve* in high-tech ratings. To examine this question more closely, we first form two lists of technical ratings. While not exhaustive, these lists represent the most stringent enlistment requirements and, thus, many of the most technical jobs in the Navy.

Technical ratings

In this subsection, we focus on the number and proportion of Sailors who are *promised* a technical rating, as well as the number and proportion who *achieve* a technical rating.

The most restrictive definition of technical ratings includes only those in the Nuclear Field (NF). Our secondary classification is a more general group of technical ratings, including Advanced Electronics/Computer Field (AECF), Avionics Technician (AV), Cryptologic Technicians (CTM, CTN, CTT), Information Systems Technician (IT), Missile Technician (MT), Sonar Technician, Surface

7. The new GI Bill, which became effective in August 2009, provides more generous college benefits than the past bills. The bill was passed near the end of FY08, and thus may help to explain the spike in applications in FY08. The bill is likely to affect future recruiting, but it probably had little influence during the period covered by our data.

(STG), and Submarine Electronics Computer Field (SECF).[8] Scoring a 67 or better on the AFQT generally indicates qualification for each of these ratings; thus, tech-qualified Sailors will qualify for these ratings in most cases.

Figure 4 indicates the proportion of *all* Sailors who initially were promised these ratings in each fiscal year. Over the period covered by our data, the proportion of Sailors promised nuclear ratings stayed roughly constant, while the proportion promised other technical ratings increased sharply. At the beginning of the period, far more Sailors received a promise of a nuclear rating than a nonnuclear technical rating. By the end of the period, the opposite condition held. This is one measure of the Navy's increasing skill requirements; by 2008 and 2009, far more Sailors were promised a technical rating than a decade earlier, despite the overall decrease in accession numbers. Today, over 30 percent of Sailors enter the Navy with the expectation that they will serve in a nuclear or other high-tech rating. Also, recall that our list of technical ratings includes only a limited number; other ratings that have technical aspects are not included here.

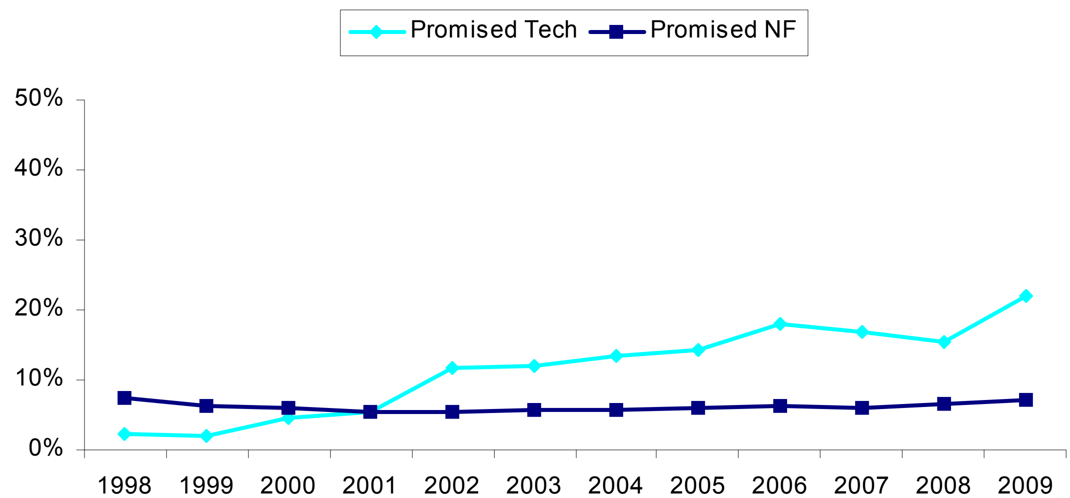
Not all of the Sailors who are qualified for technical ratings will serve in them, and some technical ratings will be filled by Sailors whom we do not consider highly qualified because of the variation in rating-specific requirements. In particular, highly qualified Sailors may opt out of the nuclear program because of the increased commitment attached to nuclear ratings.

To summarize, the overall quality of Navy accessions has increased in recent years and so has the proportion of Sailors promised technical ratings (while the proportion promised nuclear ratings has remained roughly constant). If highly qualified Sailors do not serve in technical

8. In the PRIDE files, those who are promised a nuclear rating have a designation of NF (Nuclear Field) for rating promised. We consider those who reach full duty status, achieve a first rating of EM (Electrician's Mate), MM (Machinist's Mate), or ET (Electronics Technician), and have a nuclear Enlisted Management Community (EMC) to have achieved a nuclear rating. We consider Sailors who reach full duty status and hold one of the (nonnuclear) technical ratings to have achieved a technical rating.

positions, this may represent an allocative inefficiency; also, highly qualified Sailors who entered the Navy for technical training and jobs may be dissatisfied if their ratings do not provide such opportunities. However, technically qualified Sailors may also excel in nontechnical ratings and jobs. Next, we examine nuke- and tech-qualified Sailors separately to look for patterns in the ratings they are promised and serve in. We also examine attrition data on these groups.

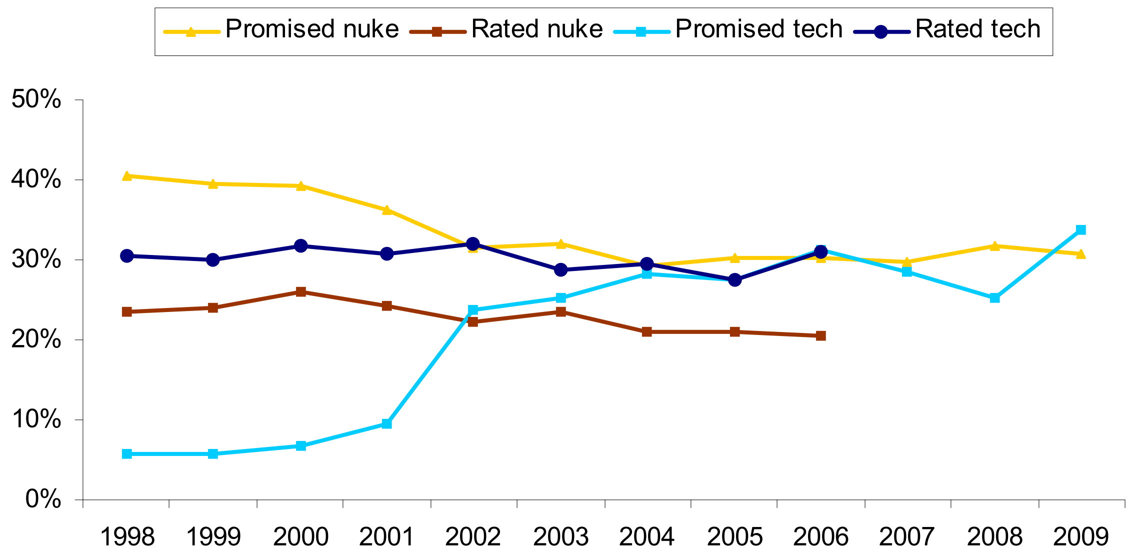
Figure 4. Proportion of Sailors promised nuclear and technical ratings, by fiscal year[a]



a. "Technical ratings" include AECF, AV, CTM, CTN, CTT, IT, MT, STG, and SECF.

First, we look only at nuke-qualified Sailors. Recall that these Sailors have high levels of technical aptitude; in general, they would also qualify for any other technical rating. As shown in figure 5, even among these highly qualified Sailors, the washout rate in nuke training is substantial every year; many more Sailors are promised nuclear ratings than achieve those ratings. Indeed, nuke-qualified Sailors are more likely to achieve a (nonnuclear) technical rating than a nuclear rating. Over time, however, the proportion of nuke-qualified Sailors who are promised a nuclear rating has decreased, while the proportion promised a technical rating has increased sharply. (In a typical year, 45 to 65 percent of nuke-qualified Sailors are promised a nuclear or technical rating, but 50 to 55 percent usually achieve such a rating.)

Figure 5. Ratings promised and achieved, nuke-qualified Sailors, by fiscal year of accession

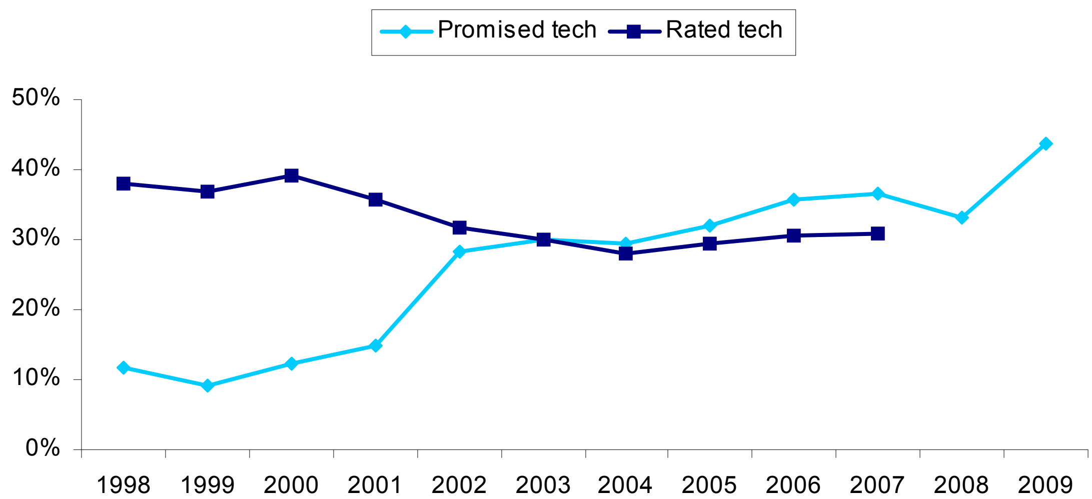


Thus, figure 5 suggests that, today, nuke-qualified Sailors are more likely to end up in the rating category they were promised (nuclear or nonnuclear technical) than in the past. As the proportion of nuke-qualified Sailors *and* the proportion of nonnuclear technical jobs have increased, these highly qualified Sailors are more likely to *be promised* and to *serve* in nonnuclear technical ratings. (A decade ago, nuke-qualified Sailors were rarely promised nonnuclear technical ratings, although many of these Sailors did eventually end up in such ratings.)[9] Next, we examine similar statistics for those who are qualified for high-tech ratings but not for nuclear ratings.

Figure 6 includes those who are eligible for technical nonnuclear ratings. Before 2001, more of these Sailors achieved such ratings than were promised them. Since 2003, tech-qualified Sailors have been more likely to be promised a technical rating than to achieve one. Today, about 30 percent of these Sailors achieve a technical rating.

9. Changes in bonus availability and amounts, as well as the use of GENDETs and other factors, certainly explain some of this trend.

Figure 6. Ratings promised and achieved, tech-qualified nonnuclear Sailors, by fiscal year of accession

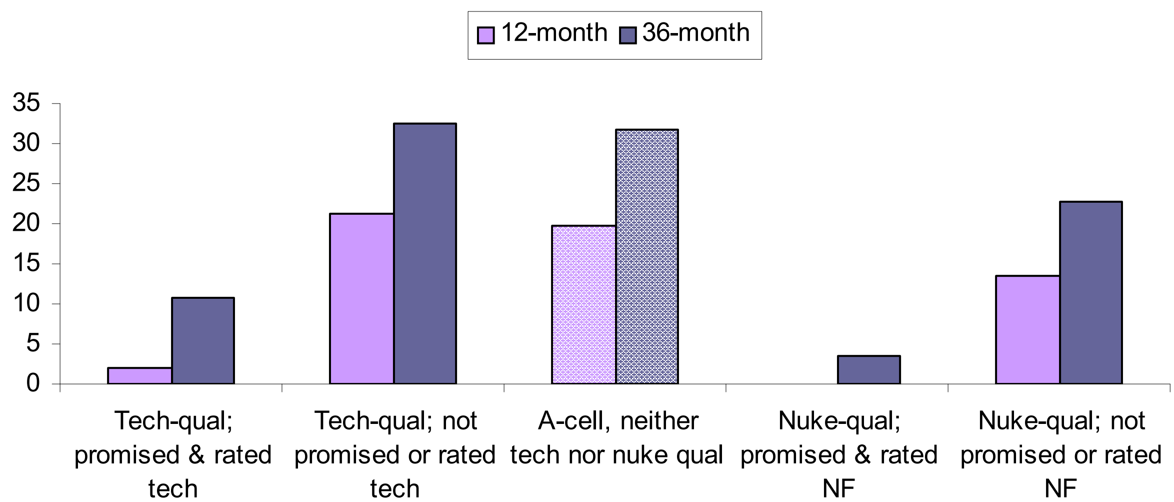


Figures 5 and 6 indicate that today, tech-qualified Sailors are more likely than in the past to end up in the rating they were promised. This suggests an increase in job match for these Sailors; today's Sailors seem to have fairly accurate expectations of their ratings during first term. Figures 5 and 6 also show that, as the number of nuclear-qualified Sailors has increased and the number of nuclear positions has remained roughly constant, the Navy has placed nuclear-qualified Sailors in other technical ratings. This suggests a good use of skilled accessions. However, this shift has decreased opportunities for tech-qualified nonnuclear Sailors somewhat; fewer of these Sailors achieve technical ratings today than in the past (figure 6).

Overall, about half of nuke-qualified Sailors and the majority of tech-qualified Sailors do *not* serve in nuclear or technical ratings. Because our measure of technical ratings is quite focused, it is possible that many of these Sailors serve in ratings that require some technical skills but are not included in our definition. However, the data suggest that substantial numbers of Sailors with AFQT scores and education credentials to serve in technical ratings actually serve in nontechnical (or less technical) ratings.

Finally, we look at one measure of performance, first-term attrition. Figure 7 shows the 12- and 36-month attrition rates of several specific groups. The first two sets of columns represent the attrition rates of high-scoring Sailors; they are divided based on whether each was promised and received a technical rating. The last two sets of columns indicate the attrition rates of nuke-qualified Sailors, again divided based on whether each was promised and attained a nuclear rating. The center columns indicate the attrition rates of A-cell Sailors who were not high-scoring or nuke-qualified and were not promised technical ratings.

Figure 7. Attrition rates of highly qualified Sailors [a]



a. See text for definitions of tech-qualified and nuke-qualified Sailors. Data span FY99 through FY06.

Figure 7 shows that qualified Sailors who were *not* promised technical ratings have higher attrition rates in the first 36 months than Sailors who qualified for, were promised, and achieved technical ratings.[10] The difference is especially stark among nuclear-qualified Sailors; however, highly qualified Sailors who do not serve in technical ratings have attrition rates that are only slightly above those of other A-cell Sailors.

10. Figure 7 excludes any Sailor who was promised a technical or nuclear rating but did not achieve it. These Sailors have very high attrition rates.

Of course, this figure presents only descriptive statistics and does not determine *why* technically qualified Sailors do not serve in technical ratings or *why* these Sailors have high rates of attrition. A complete examination of this question is beyond the scope of this work and could include many other factors that also explain attrition. For example, perhaps those Sailors who are considered highly qualified by our benchmarks also have mitigating factors known to recruiters or detailers, or perhaps these Sailors do not wish to commit to the longer obligations required in many technical ratings.

Still, this figure suggests that matching highly qualified Sailors with technical ratings may have the potential to improve overall performance. Paired with our findings (presented earlier) that many technically qualified Sailors serve in nontechnical ratings, this suggests that tracking performance by finer gradiations than A-cell versus others could pay dividends, as could exploring the reasons for job match among highly qualified recruits.

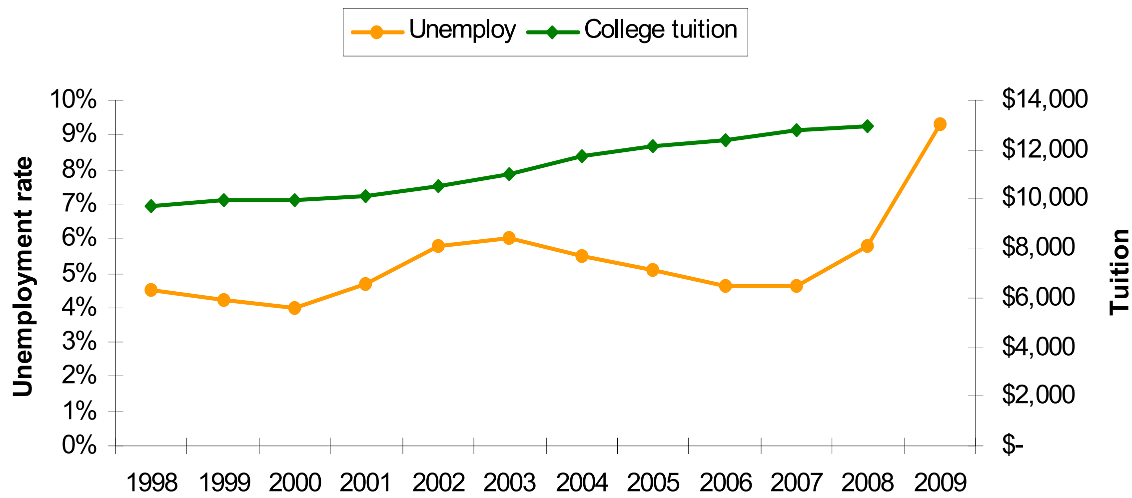
In particular, we do not know the extent to which highly qualified recruits were steered into specific ratings by enlistment bonuses or the detailing process; neither do we know whether the highly qualified recruits in nontechnical ratings requested particular nontechnical ratings. However, the stark differences in attrition shown in figure 7 suggest that a careful examination of job match among technical Sailors could pay large dividends.

Finally, these findings suggest that, as the Navy becomes more technical and is able to place more technically qualified Sailors in technical ratings, attrition may decrease because of this factor alone.

The civilian economy and regional variation

Next, we present a few details on the civilian economy during this period (see figure 8). While the unemployment rate varied widely over the period covered by our data, the cost of college increased steadily and substantially. The increasing cost of college is likely to make the military more attractive; the effect could be larger or smaller for the most qualified applicants compared with other applicants.

Figure 8. Trends in unemployment and college tuition[a]



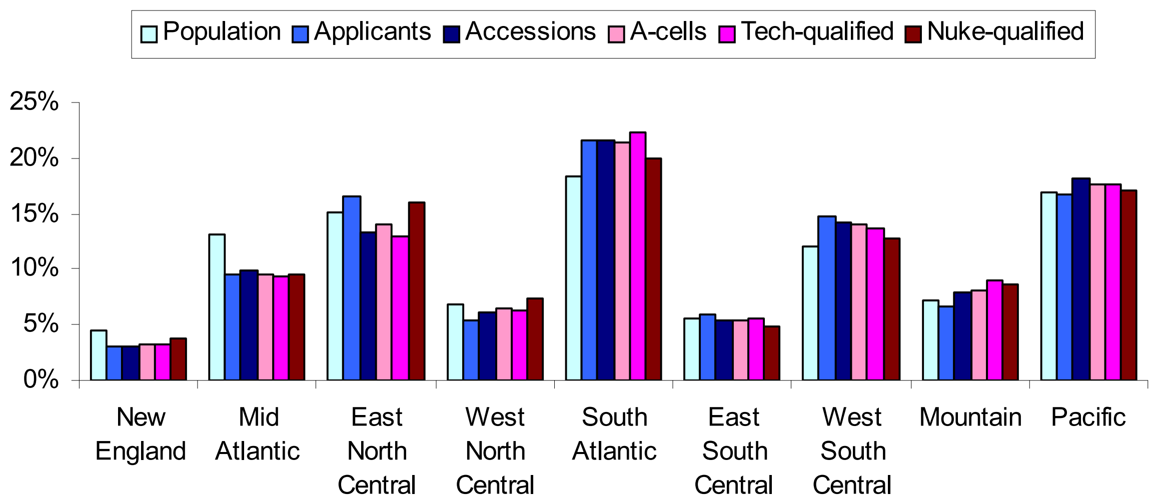
a. Unemployment rate: Current Population Series, calculated by the Bureau of Labor Statistics. College tuition includes cost of tuition, room, and board at public 4-year institutions in constant dollars (see Digest of Education Statistics 2008, table 331).

Because of our interest in determining whether the most highly qualified applicants access from the same areas and in the same patterns as other A-cell applicants, we also present a few descriptive statistics on variation across states and regions. First, we examine the proportion of accessions from each Census division, as well as the proportion that fall into A-cell, tech-qualified, and nuke-qualified categories. In each case, we also indicate the proportion of the young male population (aged 18 to 24) in the region.[11] As figure 9 indicates, there are differences between the divisions. The main driver is population; divisions with higher populations have more recruits. However, there are some other differences that could reflect variation in propensity or economic opportunity. For example, there are fewer applicants from the Middle Atlantic region than we would expect based on the population. However, the measures of applicants, accessions, and highly qualified accessions appear to be closely correlated. The divisions with a high proportion of A-cell accessions tend to have a relatively high

11. We present these numbers for a single year, FY07, for ease of interpretation. The patterns are very similar across years.

proportion of tech-qualified and nuke-qualified accessions. We use state-level models in the next section to more precisely examine the differences between divisions.

Figure 9. Proportions of youth population. applicants, accessions, and highly qualified accessions, by Census region[a]



a. Data from FY07. There is no substantial difference in distribution by Census region across fiscal years. See appendix A for complete list of states by Census division.

When looking at the state-level data, the differences initially appear more stark. In table 1 of appendix A, we report the states with the largest and smallest proportions and absolute numbers of A-cell, highly qualified, and nuke-qualified recruits. However, we also note that proportions seem to vary most widely among the smallest states; these differences are unlikely to drive differences across Census divisions.

In the next section, we present the results from our state-level models, which allow us to separate the effects of population, Census division, civilian job market conditions, and other factors on the supply of recruits.

Results

In this section, we report the results from several different models. First, we examine the question of which areas "produce" the largest number or proportion of highly qualified accessions and applicants. In this case, we aggregate our data to the state level and use state-year observations. In these models, we do not include personal characteristics of the Sailors, but we do include a number of variables describing the economic conditions of the state and the demographics of the population. Second, we model the individual application process; we do this by estimating each applicant's probability of entering DEP based on a number of personal characteristics, as well as economic conditions at the time of application and college costs.

State-level results

Our state-level dataset includes 510 observations (50 states plus the District of Columbia) over 10 years. We experimented with a number of educational variables that were available for only a subset of these years, such as college tuition, high school quality as measured by state-level completion rates, and college availability as measured by seats per 100 high school graduates. These variables are available for a limited number of years; also, they are highly correlated. Aside from the multicollinearity problems with including them, limiting the years of our data to those for which the variables are available drastically reduced the variation of the unemployment rate. Therefore, we do not include them in our preferred specification.[12]

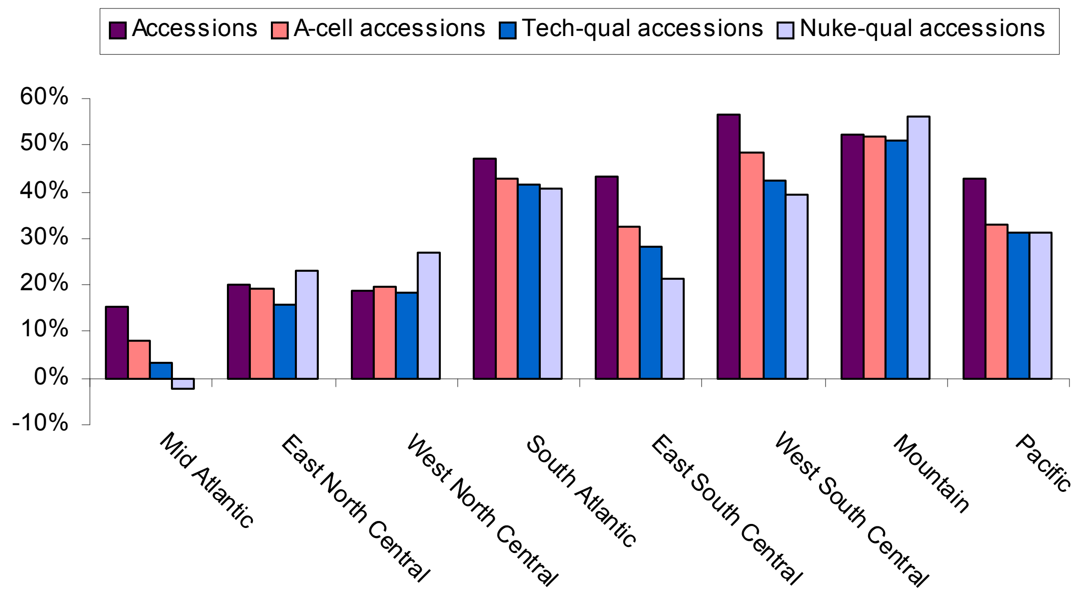
12. We suggest that future research should continue to track and experiment with these variables since they may have potential to improve model performance in future periods. We did include the college tuition variable in our individual-level model explaining DEP entry; see table 6, appendix B.

We ran a series of regressions, explaining the total number of applicants and the numbers of A-cell, tech-qualified, and nuke-qualified applicants, as well as the total number of accessions and the numbers of A-cell, tech-qualified, and nuke-qualified accessions. Because of the vastly different numbers of applicants and accessions across states, our preferred specification is a log-linear model with the log of the number of applicants or accessions as the dependent variable. Independent variables included the log of the male youth population, the unemployment rate, the percentage of the population living in a suburban area, percentages of the population that are African-American or Hispanic, and indicators of the fiscal year and Census division.[13] In a log-linear specification, the coefficients on the variables approximate the increase in the percentage of applicants or accessions associated with a one-level increase in the unemployment rate, percent urban, fiscal year, or Census region. Figures 10 and 11 present approximate marginal effects from our preferred specifications. We present the effects on accessions only; the results of our applicants' models are substantively similar and appear in appendix B.

First, we discuss a few variables not included in figures 10 and 11. It is not surprising that the male youth population (defined as the number of men age 18 to 24) has a very strong effect on accessions; figure 9 demonstrated this effect as well. We would expect a coefficient of roughly 1, and this is the case in our results; an increase in the number of young men produces a nearly equal increase in the number of accessions. Urbanicity is another key variable. States with more suburban areas produce fewer recruits—especially highly qualified recruits. This could reflect different opportunities. Also, states with higher percentages of African-American and Hispanic populations produce fewer highly qualified recruits. This also could reflect differences in opportunities.

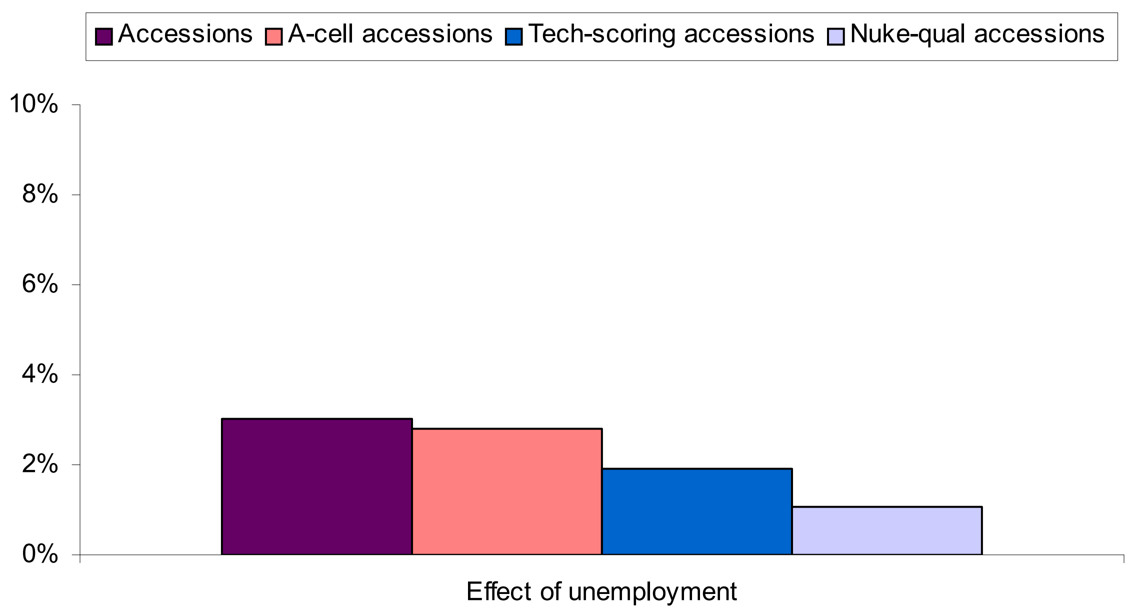
13. Each regression also includes a constant term. We tested a number of additional variables, such as average manufacturing wage. Models using unemployment rate alone performed better; we consider unemployment as a proxy for general labor market conditions. Complete regression results appear in appendix B.

Figure 10. Differences in accessions, by quality and Census division[a]



a. See appendix A for a list of states in each Census division. These differences were calculated holding constant youth male population, urbanicity, ethnicity, unemployment rate, college access, and year. See appendix B for complete regression results.

Figure 11. Effects of a 1-percentage-point increase in unemployment on accessions[a]



a. These effects were calculated in separate equations holding constant young male population, state demographics, Census division, and year. Levels of significance follow: accessions, < 5 percent; A-cell accessions, < 6 percent; high-scoring accessions, insignificant; nuke-qualified accessions, < 11 percent. See appendix B for complete regression results.

Figure 10 shows the differences across Census divisions.[14] In many cases, differences are likely caused by unmeasured division-specific factors. For example, the South Atlantic division produces more recruits, more A-cell recruits, and more tech- and nuke-qualified recruits than the New England or Middle Atlantic divisions, even after correcting for differences in population and education levels. The South Atlantic division—including states from Delaware to Florida—historically has been a strong source of recruits. Some regions produce fewer highly qualified recruits than others, and some produce more or fewer highly qualified recruits than we might expect based on population and other factors. In general, however, the proportion of A-cells from each division is very similar to the proportion of highly qualified accessions.

Figure 11 presents the effect of unemployment on accessions. The marginal effect of the unemployment rate is measured as a change in applicants due to a one-unit change in unemployment (during the period covered by our data, the unemployment rate changed by about 20 percent). Thus, the effects of such a change are much smaller than the between-division effects (note the scale used in figure 11). Figure 11 indicates that, when the unemployment rate changes by 5 percentage points (for example, an increase in the rate from 5 to 10 percent), the number of accessions is expected to increase about 15 percent. Although estimated in a somewhat different manner, this result is roughly comparable to that of [5]. The effect of unemployment on A-cell, tech-qualified, and nuke-qualified accessions, however, is progressively smaller; given the same increase in the unemployment rate, the number of nuke-qualified accessions is expected to increase by only about 5 percent and the estimate is considerably less precise. These results suggest that the most qualified Sailors are *less* responsive to changes in the civilian economy. This may reflect these Sailors' relatively plentiful civilian opportunities, or that these Sailors are deciding between college and the military and thus are less affected by the civilian labor market.

Thus, our state-level models indicate that the unemployment rate generally has the expected effect on accessions, but the effect appears to

14. We exclude division 1, New England, so all results are interpreted as comparisons with New England, correcting for differences in population and other factors in the model.

be smallest for the most qualified Sailors. Also, the effect of unemployment is small compared with the substantial differences across Census divisions. As an alternative to controlling for college tuition and avbailability, we next model each person's decision to enlist in the Navy and enter DEP. (In such an individual model, we will have many more observations and much more variation; also, individual models allow us to specify characteristics of the person making the decision rather than being limited to state-level measures.)

Applicants and accessions

Our applicant files include information on nearly 1.1 million Navy applicants. During the period of interest, about 584,000 Sailors entered DEP, and roughly 340,000 of them were A-cells. Because we would like to model the decision process at the MEPS with a particular focus on how economic conditions affect this process and because of the sharp increase in applicants in recent years (resulting in longer periods between application and accession), we model the probability that a person *enters DEP* rather than the probability that a person officially enters the Navy.[15]

We model this probability as a function of the person's characteristics (age, gender, ethnicity, marital status, and education credential) as well as the fiscal year and characteristics of the person's home state (education levels and unemployment rate, as well as college tuition).

Our basic model includes only those applicants who hold a high school diploma or equivalent credential *and* score at least 50 on the AFQT (i.e., A-cells). Figure 12 presents several marginal effects of interest from our basic models; we estimate models including all A-cell applicants, only tech-qualified applicants, and only nuke-qualified applicants.[16] We present a set of marginal effects from each of these models; complete results appear in appendix B.

15. In this subsection, we exclude 2009 applicants because in many cases we do not observe their accession or entry into DEP.

16. The dependent variable of interest ("enters DEP") is a binary variable (taking on either a value of "0" for those who do not enter DEP or a value of "1" for those who do). Therefore, we estimate the model using a logit (logistic) framework. In a logit model, the coefficients do not have a direct interpretation; rather, we calculate the marginal effects of the variables of interest.

Figure 12. Marginal effects—impact of college tuition, education, and age on probability of entering DEP

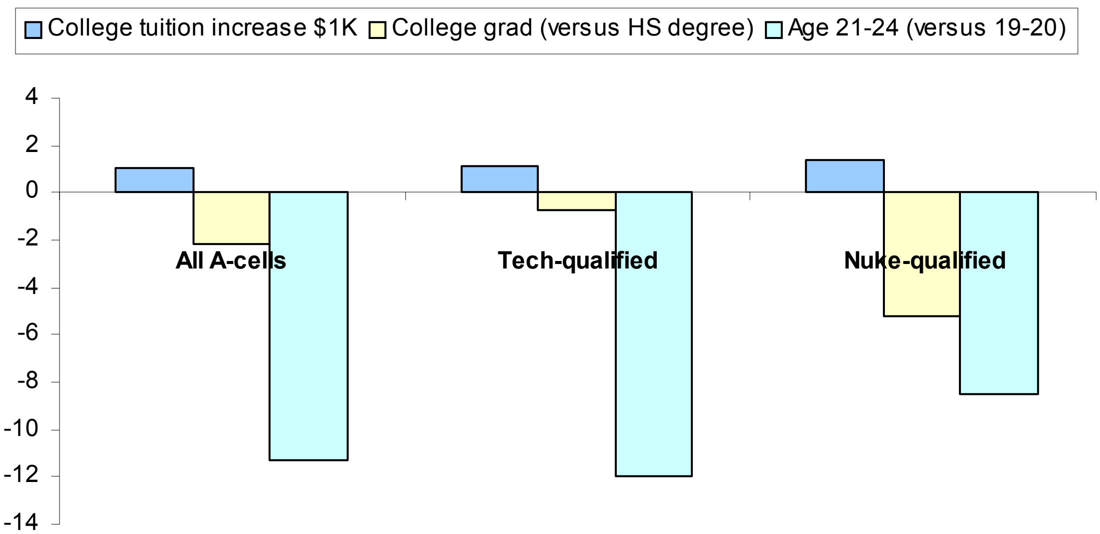


Figure 12 indicates that college tuition does have a real and substantial effect on the probability that an applicant will enter DEP; a $1,000 increase in tuition and fees increases the probability that an A-cell applicant will enter DEP by 1.1 percentage points. The effect is larger for nuke-qualified applicants, for whom a $1,000 increase in tuition and fees is associated with roughly a 1.4-percentage-point increase in the probability of entering DEP.[17] Figure 12 also demonstrates that the effect of college tuition is small compared with other variables in the model. The applicant's own education status has a very large effect on the probability of entering DEP. Those who have completed a college degree (either 2-year or 4-year) are 2 to 5 percentage points less likely than high school diploma graduates to enter DEP. This effect, too, is largest for nuke-qualified applicants. The applicant's

17. The unemployment rate had a small and statistically insignificant effect in these models. However, in a similar model excluding tuition, the effect of unemployment was positive and statistically significant; a 5-percentage-point change in unemployment altered the predicted probability of entering DEP by about 3 percent.

age also has a large effect. Among high-scoring applicants, those who are 21 to 24 are about 11 percentage points less likely to enter DEP than similar applicants age 19 to 20. Among nuke-qualified applicants the effect of age is smaller, but still quite substantial.

Nuke-qualified applicants do tend to be older than other applicants and are more likely to have completed college. The differential effects of age and education may be the result of different opportunities or backgrounds of these older, more educated applicants. For example, these applicants may be more sensitive to availability of specific ratings, or they may be more likely to have other characteristics requiring waivers. It is also possible that some of these applicants are eligible for and elect to join the Officer Corps instead of the enlisted ranks.

Conclusions

To summarize, our results suggest that there are large and substantial differences in the production of recruits across some Census divisions, but the main driver is differences in population. Differences in propensity surely exist, and some divisions are especially likely or unlikely to produce the highest quality recruits. High-quality recruits, however, generally come from the same areas as other recruits.

The civilian unemployment rate has a substantial effect on the number of enlistees. The effect is smallest, however, for the most qualified applicants; the effect of the unemployment rate on nuke-qualified accessions is about one-third the effect on total accessions or on A-cell accessions. Thus, a decrease in the unemployment rate is predicted to have a larger percentage effect on the total number of accessions or the number of A-cell accessions than on the number of highly qualified accessions. This suggests that highly qualified accessions either have the most stable civilian opportunities or are the most likely to consider college in place of enlistment. Consistent with the latter, our model predicting the probability that a person will enter DEP indicates that college tuition costs have a slightly larger effect for nuke-qualified applicants than for other A-cell applicants.

For all applicants, having completed college decreases the probability of entering DEP, as does being at least 21 years of age. We do note that nuke-qualified applicants are older than other A-cell applicants and are more likely to have completed college. This suggests that venues other than high schools are likely to be the most productive places to recruit such highly technical Sailors.

In general, our results are consistent with many of our descriptive statistics. In particular, figures 1 and 2 show that variation in the numbers of highly qualified applicants and accessions over time is smaller than variation in the total number; highly qualified applicants have applied to and enlisted in the Navy more consistently than others over the past decade. In addition, the most qualified applicants hold a larger proportion of positions in the Navy today than in the past. This change, combined with an increased probability of placing Sailors in ratings they were promised and qualified for, suggests that today's Sailors are more likely to have accurate expectations of their first term and are quite likely to use their technical skills in their Navy jobs. However, about half of nuke-qualified Sailors do not serve in nuclear ratings, and over half of technically qualified Sailors do not serve in technical ratings. Given the relationship between attrition and serving in a technical rating, this suggests that the Navy would be well-served by understanding the pathways technical Sailors take to non-technical ratings.

Conclusions

Over the past decade, the Navy recruiting climate has changed in a number of ways. While the Navy's overall mission has decreased, the need for Sailors with technical aptitude has increased. Over this same period, the civilian unemployment rate has fluctuated dramatically, while the cost of college increased steadily. In this project, we look at several aspects of Navy recruiting, with an emphasis on recruiting those with technical aptitude.

Three main developments drive the Navy's need for technically skilled recruits. First, advances in science and technology have caused the Navy's weapon systems to become more complex. Second, the increasing use of more efficient, software-based technology means that people with information technology experience are needed for development and implementation of these software systems. Finally, the model of network-centric warfare demands military personnel who can use technology to collect and analyze complex information and then can use this information to make critical decisions. For all these reasons, the Navy needs to recruit many Sailors with technical aptitude.

Of course, technical aptitude and skills are also quite desirable in many civilian jobs; our review of the civilian literature found that civilian companies sometimes use different methods than the Navy uses to recruit workers with technical aptitude. In particular, partnerships with academic institutions, various types of social networking, and demonstrations or competitions provide suggestions for the Navy to expand recruiting beyond the current model.

Over the past decade, the quality of Navy accessions has increased substantially as the overall mission has fallen. In particular, the Navy recruits more Sailors who are qualified to serve in technical or nuclear ratings today than 10 years ago, despite a drop in the overall mission of about 25 percent. Quality has increased by many measures;

overall applications peaked sharply in 2008, causing a substantial increase in the size of the DEP pool. Throughout these changes, the Navy has maintained the ability to attract and recruit those with technical aptitude. The Navy requires many more Sailors with technical aptitude today than in the past; in particular, this growth has occurred in nonnuclear technical ratings, which generally require an AFQT score in the top third of the distribution. This growth is a measure of the Navy's increasing reliance on technology and Sailors with technical aptitude.

In this paper, we test several definitions of technical aptitude and focus on the recruiting and performance of highly qualified applicants. We trace the path of these applicants through the application process and into the Navy.

A central finding of this research is that, among the most qualified, those serving in highly technical ratings have substantially lower attrition than those serving in nontechnical ratings. This could indicate that highly qualified Sailors in nontechnical ratings are bored and underperform as a result, or that the process of matching Sailors to ratings selects only the very top performers among many with high test scores. To the extent that highly qualified Sailors continue to enter the Navy in numbers that exceed the requirements, determining ways to best use these Sailors' talents will become increasingly important.

Today, the Navy has "excess capacity" in the sense that a substantial proportion of technically qualified Sailors do not serve in technical ratings. While this may represent an inefficiency, it also will provide the Navy with a cushion when the recruiting climate begins to degrade.

Determining the reasons why some Sailors with technical aptitude serve in nontechnical ratings is beyond the scope of this research. The detailing process, availability of positions in key ratings, and the enlistment bonus structure surely affect this process. Exploring this process in more detail is likely to pay substantial dividends in the future. In particular, there is little research detailing the effects of the current enlistment bonuses, especially on Sailors with technical aptitude. Bonuses may play a major role in channeling these Sailors into key ratings, or they may have relatively little effect on those with technical aptitude. Such research could be very helpful in increasing the levels of job match and performance within the Navy.

We also explore the effects of several economic conditions. We find little evidence that the most qualified applicants or accessions are more sensitive than others to civilian economic conditions; in fact, highly qualified applicants seem somewhat less sensitive to the unemployment rate than other A-cell applicants. While the results from our individual model suggest that the most qualified applicants are sensitive to college costs, the effects of individual characteristics, such as age and education, are much larger than the effects of college costs.

Finally, we explore regional differences. While there are substantial differences in the number of recruits per Census division, the youth population is a major driver in these differences. High-quality recruits, however, tend to come from the same areas as other recruits. The differences in personal characteristics are likely to be more relevant for recruiting, such as the fact that the most qualified Sailors tend to be older and have more education than others. These characteristics also make it less likely that an applicant will enter DEP. These findings suggest that recruits with the highest technical aptitude can be found not by focusing attention on certain regions of the country but by exploring venues outside traditional high schools.

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Appendix A: Data sources

This appendix includes detailed information on our data, as well as a list of the states in each Census division.

Military data

The DMDC MEPCOM data were missing some information. Consequently, we made the following deletions:

- The approximately 2 percent of the sample having no AFQT scores
- The approximately 2 percent of the sample scoring below 10 on the AFQT (only 1 percent of these applicants accessed, never more than 20 per year)
- The 458 applicants missing the key ASVAB subscores, only 49 of whom accessed.[18]

In addition, we deleted the applicants in our files with "bad" ZIP codes, thereby decreasing the sample size by less than 2 percent. Some of these ZIP codes are associated with territories or APO addresses; we deleted them because we have no information on unemployment or college costs in these areas. Other ZIP codes are not legitimate and may have resulted from data entry errors.

Civilian data

The Current Population Survey (CPS) dataset is built on monthly inquiries of a randomly selected group of households. The survey is structured as follows: each household is interviewed for 4 months, then ignored for 8 months, and finally interviewed for 4 additional

18. We use standardized ASVAB scores in our calculations.

months. After this, the household exits the survey permanently. Therefore, each month some new households enter the survey, some households permanently exit the survey, and others begin an 8-month hiatus. This structure allows the CPS to collect data over 16 months while conducting only 8 interviews, thus lowering costs as well as disruptions to the household members who take part in the survey. Those households being interviewed for the 4th month in a row (whether they are about to exit the survey for good or are about to go on hiatus for 8 months) are referred to as *outgoing rotation groups.* Questions about usual earnings and usual hours of work are asked of these groups. Merging 12 months' worth of outgoing rotation group observations thus yields a relatively large sample, including more than 90,000 households and more than 300,000 individuals.[19] These data are referred to as the merged Outgoing Rotation Group (ORG) files.

The ORG files offer several potential advantages over other datasets. The main advantage is that the sample size allows the estimation of reasonably precise state-level figures. We used the ORG files to produce state-level measures of urbanicity, ethnicity, and education of the population. Our unemployment rates come from the local area unemployment statistics (www.bls.gov/lau); this series also is based on the CPS.

We used Integrated Postsecondary Educational System (IPEDS) data to calculate the tuition and fees at state schools. We first formed a sample of colleges and universities as follows: we selected public, 2- and 4-year, degree-granting institutions located in the 50 states or Washington, DC, that are eligible for Title IV (Federal Financial Aid) funds. These criteria yielded information on approximately 3,300 institutions. To produce average tuition at the state level, we weighted tuition by enrollment so that very small schools with unusually high or low tuition and fees would not have a disproportionate influence on state-level costs. We inflated tuition and fees to 2008 dollars using the CPI-U-RS (Consumer Price Index Urban Research Series, see http://www.bls.gov/cpi/cpiurs1978_2008.pdf).

19. For more information on the ORG files, see http://www.nber.org/data/cps_index.html.

Census divisions

The components of the nine Census divisions follow:

- Division 1 (New England): Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
- Division 2 (Middle Atlantic): New Jersey, New York, and Pennsylvania
- Division 3 (East North Central): Illinois, Indiana, Michigan, Ohio, and Wisconsin
- Division 4 (West North Central): Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
- Division 5 (South Atlantic): Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
- Division 6 (East South Central): Alabama, Kentucky, Mississippi, and Tennessee
- Division 7 (West South Central): Arkansas, Louisiana, Oklahoma, and Texas
- Division 8 (Mountain): Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming
- Division 9 (Pacific): Alaska, California, Hawaii, Oregon, and Washington.

The divisions make up four regions: divisions 1 and 2 form the Northeast region, divisions 3 and 4 form the Midwest region, divisions 5 through 7 form the South region, and divisions 8 and 9 form the West region.

Largest and smallest numbers and proportions of accessions

Table 1 lists the states with the highest and lowest proportions, as well as the largest and smallest numbers, of accessions. The lowest numbers of recruits are produced by states with small populations. Some of these states, such as North Dakota and Vermont, also produce high proportions of qualified recruits. The District of Columbia, however, produces the fewest recruits in each category and among the smallest proportions of high-quality recruits.

Table 1. Largest and smallest ***proportions*** and ***numbers*** of A-cell, highest-qualified, and nuke-qualified recruits

A-cell	Tech qualified	Nuke qualified
	Highest proportions	
ND	ND	ND
VT	VT	AK
NH	NH	NH
NE	SD	WI
WI	WA	UT
	Lowest proportions	
MS	MS	MS
DC	DC	LA
LA	HI	DC
HI	LA	AL
GA	AL	HI
	Highest number	
CA	CA	CA
TX	TX	TX
FL	FL	FL
NY	NY	PA
OH	OH	OH
	Lowest number	
DC	DC	DC
VT	VT	VT
ND	RI	ND
DE	DE	RI
RI	ND	DE

Appendix B: Regression results

While the main paper features only the most pertinent results from our regression models, this appendix includes complete results. We divide the results as we do in the paper; first we list state-level results, then results from individual models explaining the decision to enter the Delayed Entry Program (DEP).

State-level results

Table 2. Regression results: number of applicants and A-cell applicants per state [a, b]

Variable	Applicants		A-cell applicants	
	Coefficient	Standard error	Coefficient	Standard error
Youth male population	1.06*	0.019	1.08*	0.019
Unemployment rate	0.023	0.014	0.013	0.014
Percent suburban	-0.076	0.060	-0.15*	0.061
Percent African-American	-0.35*	0.17	-1.33*	0.16
Percent Hispanic	-0.10	0.19	-0.53*	0.19
Middle Atlantic state	0.26*	0.065	0.127*	0.051
East North Central state	0.25*	0.058	0.196*	0.059
West North Central state	0.14*	0.046	0.127*	0.047
South Atlantic state	0.53*	0.056	0.471*	0.056
East South Central state	0.54*	0.062	0.392*	0.063
West South Central state	0.63*	0.059	0.499*	0.060
Mountain state	0.51*	0.047	0.494*	0.048
Pacific state	0.53*	0.020	0.444*	0.053

a. Dependent variable: (Natural log of) applicants or A-cell applicants. Youth male population includes men age 18 to 24; this variable is logged like the dependent variable. Percent suburban, African-American, and Hispanic include percentage of state population that falls into each category. Model also includes fiscal year dummy variables, as well as a constant. New England Census division is the excluded category. See appendix A for a complete list of states included in each Census division.

b. * Indicates statistical significance at the level of 5 percent or better.

Table 3. Regression results: number of tech- and nuke-qualified applicants per state[a, b]

Variable	Tech-qualified applicants		Nuke-qualified applicants	
	Coefficient	Standard error	Coefficient	Standard error
Youth male population	1.09*	0.019	1.09*	0.021
Unemployment rate	0.0147	0.014	0.0117	0.015
Percent suburban	-0.161*	0.061	-0.146*	0.067
Percent African-American	-1.69*	0.16	-2.36*	0.181
Percent Hispanic	-0.74*	0.19	-1.17*	0.21
Middle Atlantic state	0.0519	0.066	-0.0615	0.072
East North Central state	0.152*	0.059	0.158*	0.065
West North Central state	0.114*	0.047	0.167*	0.051
South Atlantic state	0.441*	0.056	0.359*	0.062
East South Central state	0.338*	0.066	0.223*	0.069
West South Central state	0.432*	0.060	0.358*	0.066
Mountain state	0.511*	0.048	0.535*	0.052
Pacific state	0.428*	0.053	0.386*	0.059

a. Dependent variable: (Natural log of) high-scoring applicants or nuke-qualified applicants. Youth male population includes men age 18 to 24; this variable is logged like the dependent variable. Percent suburban, African-American, and Hispanic include percentage of state population that falls into each category. Model also includes fiscal year dummy variables, as well as a constant. New England Census division is the excluded category. See appendix A for a complete list of states included in each Census division.

b. * Indicates statistical significance at the level of 5 percent or better.

Table 4. Regression results: number of accessions and A-cell accessions per state [a, b]

Variable	Accessions		A-cell accessions	
	Coefficient	Standard error	Coefficient	Standard error
Youth male population	1.08*	0.019	1.09*	0.020
Unemployment rate	0.0301*	0.014	0.0279*	0.015
Percent suburban	-0.140*	0.062	-0.194*	0.064
Percent African-American	-0.856*	0.168	-1.48*	0.17
Percent Hispanic	-0.467*	0.197	-0.755*	0.20
Middle Atlantic state	0.154*	0.068	0.0799	0.069
East North Central state	0.200*	0.060	0.191*	0.062
West North Central state	0.189*	0.048	0.196*	0.049
South Atlantic state	0.472*	0.057	0.427*	0.059
East South Central state	0.431*	0.065	0.324*	0.066
West South Central state	0.567*	0.061	0.483*	0.063
Mountain state	0.523*	0.049	0.520*	0.050
Pacific state	0.427*	0.054	0.329*	0.056

a. Dependent variable: (Natural log of) accessions or A-cell accessions. Youth male population includes men age 18 to 24; this variable is logged like the dependent variable. Percent suburban, African-American, and Hispanic include percentage of state population that falls into each category. Model also includes fiscal year dummy variables, as well as a constant. New England Census division is the excluded category. See appendix A for a complete list of states included in each Census division.

b. * Indicates statistical significance at the level of 5 percent or better.

Table 5. Regression results number of tech- and nuke-qualified accessions per state[a, b]

Variable	Tech-qualified accessions		Nuke-qualified accessions	
	Coefficient	Standard error	Coefficient	Standard error
Youth male population	1.10*	0.021	1.11*	0.024
Unemployment rate	0.019	0.016	0.0108	0.018
Percent suburban	-0.207*	0.069	-0.267*	0.077
Percent African-American	-1.95*	0.19	-2.41*	0.21
Percent Hispanic	-0.957*	0.22	-1.28*	0.24
Middle Atlantic state	0.0316	0.075	-0.0235	0.083
East North Central state	0.159*	0.067	0.230*	0.075
West North Central state	0.182*	0.053	0.269*	0.059
South Atlantic state	0.415*	0.063	0.405*	0.071
East South Central state	0.281*	0.071	0.214*	0.080
West South Central state	0.423*	0.068	0.394*	0.076
Mountain state	0.509*	0.054	0.560*	0.061
Pacific state	0.312*	0.060	0.314*	0.067

a. Dependent variable: (Natural log of) high-scoring accessions or nuke-qualified accessions. Youth male population includes men age 18 to 24; this variable is logged like the dependent variable. Percent suburban, African-American, and Hispanic include percentage of state population that falls into each category. Model also includes fiscal year dummy variables, as well as a constant. New England Census division is the excluded category. See appendix A for a complete list of states included in each Census division.

b. * Indicates statistical significance at the level of 5 percent or better.

Individual results

Table 6. Regression results explaining enlistees' decision to enter DEP w/ state fixed effects[a, b]

Variable	A-cell accessions Coeff.	A-cell accessions Std. error	Tech qualified Coeff.	Tech qualified Std. error	Nuke qualified Coeff.	Nuke qualified Std. error
Less than 18 years old	-0.016	0.013	-0.048	0.021*	-0.089	0.033*
19 or 20 years old	-0.060	0.013*	-0.079	0.021*	0.084	0.032*
21 to 24 years of age	-0.55	0.013*	-0.59	0.022*	-0.288	0.031*
At least 25 years old	-1.62	0.016*	-1.62	0.022*	-1.45	0.034*
Male	0.216	0.010*	0.231	0.016*	0.257	0.033*
African-American	-0.16	0.013	-0.163	0.022*	-0.105	0.049*
Hispanic	0.030	0.014*	0.018	0.022	0.130	0.038*
Asian/Pacific Islander	0.096	0.022*	0.038	0.034	0.036	0.051
American Indian	0.324	0.021*	0.32	0.034*	0.439	0.045*
Other ethnicity	-0.11	0.027*	-0.053	0.042	-0.204	0.163*
Married	-0.48	0.016*	-0.466	0.026*	-0.639	0.032*
College degree	-0.49	0.035*	-0.438	0.058*	-0.653	0.074*
High school grad	-0.46	0.031*	-0.461	0.052*	-0.489	0.069*
Unemployment rate	0.0081	0.0096	-0.0165	0.016	0.035	0.021
Percent dropouts in state	-0.01	0.0091	-0.0156	0.014	-0.043	0.020*
Percent w/ college	-0.0035	0.0054	-0.0049	0.0087	-0.019	0.012
College tuition & fees	0.049	0.008*	0.050	0.013*	0.060	0.018*
Second quarter of FY	-0.11	0.012*	-0.111	0.019*	-0.097	0.026*
Third quarter of FY	-0.34	0.011*	-0.340	0.018*	-0.321	0.025*
Fourth quarter of FY	-0.0064	0.013	0.023	0.022	-0.025	0.030

a. Excluded categories: female, white, age 18 or 19, fiscal year 2007, first quarter of fiscal year. Variables "percent dropouts in state," "percent w/college," "college tuition & fees," and "unemployment rate" are measured at the state level. Tuition & fees includes public 2- and 4-year schools only. Regressions also include fiscal year and state fixed effects, as well as a constant term.

b. * Indicates statistical significance at the level of 5 percent or better.

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