Uncertainty about Job Match Quality and Youth Turnover:

Evidence from U.S. Military Attrition

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INTRODUCTION

Mistakes are not inevitable, but they are common among youth who have just completed high school and are embarking on a career. Research by Topel and Ward (1992) shows an extremely high rate of job turnover among youth early in their career. Two-thirds of all new jobs among new workers end in the first year (p. 442). By the tenth year after entry into the labor market, more than half of young workers have held more than six jobs, and only one in twenty has held a single job for ten years (p. 448). This high degree of job mobility is an important component of the transition to stable employment (p. 474).

Unlike their civilian counterparts, youth who enter the US military must sign a contract for a specific term of enlistment. Not surprisingly in light of the findings by Topel and Ward, there are high levels of turnover among new recruits prior to the completion of their initial term of enlistment, called attrition. Each year the military must attract around 200,000 young men and women to serve their country. Since the advent of the All-Volunteer Force in 1973, the military services have found it necessary to devote significant resources in the form of recruiters, advertising, and enlistment incentives such as cash bonuses and college fund, and to offer a wide variety of initial enlistment term lengths and training possibilities to man the force. In addition to the magnitude of the enlistment effort at the front end, the services have implemented substantial personnel management changes, including counseling, in order to place and keep new recruits in the service. Nevertheless, over the 10-year period between 1988 and 1988, about 15 percent of youth who signed enlistment contracts failed to enter service and 25 percent of entrants failed to complete two years of service.[1]

Considerable research has been devoted to studying the factors related to attrition and developing policies to reduce it. Studies have found that the propensity to quit during the initial enlistment is related to personal attributes such as level of education, gender, and race. Less

[1]Rates reported in an unpublished table available from the Defense Manpower Data Center. The Army and Navy had two-year attrition rates of 26 and 27 percent, respectively, while the Air Force and Marine Corps had attrition rates of 19 and 24 percent.

educated recruits have a higher risk of attrition, leading the services to accept few non-high school graduates (non-HSGs). Just why this is so presents a puzzle because high school graduates (HSGs) certainly have better non-military alternatives than non-HSGs. It is conventional to interpret the differences in attrition by education level as a "stick-to-it" or "perseverance" effect. Differences in attrition by gender and race also present a puzzle to be explained.

Other than to appeal to so-called perseverance or persistence effects, most of the research on military attrition has been empirically driven, with little effort to explain the observed differences within the context of an economic model. This paper argues that observed demographic differences in attrition can be explained from an information-theoretic perspective. In our model, individuals sign enlistment contracts when the expected gain from military service is positive. The expected gain is based on youths' initial, or prior, forecasts of preferences for military life. Youths then update these forecasts after entering service and experiencing the realities of military life. Decision reversal – that is to say, attrition – occurs when some recruits learn from experience that their initial preference forecasts were wrong. The degree of decision reversal is related to the extent of uncertainty in initial forecasts of preferences. The demographic differences in attrition found in past research can be explained on the basis of differences in the degree of uncertainty in prior preferences for military service.

We subject the information-theoretic approach to military attrition to a variety of empirical tests using data on all individuals who signed Army and Navy enlistment contracts and entered service over the period FY 1988-1998. While the empirical analysis cannot unequivocally distinguish between the perseverance hypothesis and the sorting hypothesis of the effects of education and other demographic factors, the results are consistent with the information-theoretic approach and the view that different demographic groups face different degrees of information uncertainty in the enlistment process.

In the process of performing the empirical analysis, we approach attrition in a dynamic, multi-period framework and provide estimates of the attrition effects of factors sparsely analyzed in previous studies. Of particular interest is the effect of enlistment incentives (enlistment bonuses and college fund benefits) on attrition. Our analysis provides a large-scale test of the Salop and Salop (1976) proposition that firms can improve the quality of job matches and reduce recruiting costs with contingent compensation plans that provide more deferred compensation and less compensation up-front. Enlistment bonuses (EB) are provided up-front (after completion of initial training) while college fund benefits (CF) are available only upon successful completing of the initial enlistment. According to the Salops' story, individuals who opt for CF benefits will be individuals who have a higher prior forecast of successful completion of a first enlistment.

MODELING ENLISTMENT AND ATTRITION

A number of economists, including Jovanovic (1979, 1984), Viscusi (1979, 1980), Topel and Ward (1992), Neal (1999), and Farber and Gibbons (1996) have studied the evolution of job turnover over workers' careers. Jovanovic explains turnover in a model of job match quality, a succinct discussion of which is found in Mortensen (1986). Uncertainty about the quality of a job match can lead to early turnover as those who are revealed to be poor matches quit. As those who are revealed to be good matches remain with the firm, turnover declines with tenure. A higher degree of initial job match uncertainty induces job applicants to reduce reservation wages and accept 'risky' offers with the hope (speculation) that the match will turn out to be a good one. Inevitably, when riskier workers reduce reservation wages and take jobs on the speculation that the matches will turn out to be good ones, more end in failure.

Simon and Warner (1992) provide some evidence for this story. They studied whether job match quality is better for scientists and engineers who find jobs through inside sources such as friends and relatives who work for the employing firm or faculty advisors who know individuals at the employing firm than those who find jobs through formal (outside) sources such as placement services. They found that workers placed through outside sources have lower starting wages than those placed through inside sources, a result consistent with lower reservations for riskier workers (i.e., workers for whom information may be of lesser quality).

Furthermore, jobs obtained through outside sources were found to end at a higher rate, presumably due to the higher degree of uncertainty about the quality of the match for jobs found through such sources. But individuals who found jobs through outside sources, and who turned out to be good matches, experienced higher wage growth than those who were placed through inside sources, a result also consistent with matching theory.

In matching models, differences in worker turnover arise from differences in reservation wage strategies. In the current military setting, this would imply, for example, that greater uncertainty would reduce the reservation wage, or more accurately, the reservation military-civilian wage *differential* required to induce an individual to join. Although this is certainly plausible, we abstract from this possibility and focus instead on learning about preferences over time. The non-pecuniary characteristics of military life are quite different from the characteristics of civilian life, and there is likely to be misinformation about these characteristics prior to entry. Learning on the job about these characteristics, and the decision reversal that results from this learning is, in our view, the more plausible explanation for the high early turnover from military service.

It should not be surprising that models of military retention focus on the role of preference (taste) heterogeneity [see Gotz and McCall (1984), Daula and Moffitt (1995), Asch and Warner (2001), Hosek and Mattock (2003), and Asch, Hosek, and Clendenning (2005)]. These models assume that by the end of the initial term of service, individuals have formulated their net preference (taste) for military service (τ), which in these models is viewed as fixed and unchanging as the career progresses. At the end of the initial enlistment, and at each career decision point thereafter, individuals' retention decisions are formulated on the basis of future streams of military compensation, the fixed preference factor τ, and random shocks to the retention decision (ε).

This paper extends the formulation of the taste factor in Asch and Warner (2001) and Hosek and Mattock (2003). We suppose that the taste factor τ has 2 components. The first, p, measures the value the individual places on patriotism, pride of service, and so on, and is known with certainty. The second is the disutility of the effort required on the job, *f*, which is not known a priori. Prior to entering the military, youth form an expectation of τ, given by

$$\tau^e = p + f^e$$

where f^e is the forecasted effort required on the job. Youth who eventually enter the military will update f^e by drawing a shock υ from a distribution with mean μ_υ and variance σ_υ^2, where

$$\upsilon = f - f^e$$

and where *f* is the true disutility of in-service effort. That is, youth learn the true effort requirement only after entry. If $\mu_\upsilon = 0$, initial taste forecasts were unbiased. We raise the possibility below that taste updates might be biased downward (that $\mu_\upsilon < 0$).

We abstract from career considerations and instead model the formation and evolution of preferences over the course of a model of a single term of enlistment.[2] Let the expected net value of an enlistment to a youth who has just finished schooling and entered the labor market be

$$G_0 = w^m - w^c + \tau^e$$

where w^m is the pecuniary return to a term of military service, w^c is the return to civilian work over the same period, and τ^e is the youth's forecast at the time of enlistment of τ. Both w^m and w^c are fixed and identical across individuals, while τ^e is assumed to be normally distributed with mean μ_{τ^e} and variance $\sigma_{\tau^e}^2$. A youth signs a contract to enlist if $G_0 > 0$. The expected net value of military service to an enlistee who ships to duty immediately after signing an enlistment contract – a "direct ship" – is given by

$$G_1^* = w^m - w^c + \tau^e + \upsilon \ = w^m - w^c + \tau .$$

Let the term of military service be divided into T periods. In addition to the one-time shock υ, other, time-varying random shocks, denoted ε_t, affect attrition in each period, where $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$. Attrition occurs in period 1, and each period thereafter, if $G_t^* + \varepsilon_t < 0$.

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[2] The papers cited show how to formulate the enlistment condition when individuals expect to remain for more than one term with a non-zero probability. Because our paper focuses on attrition within the first two years – most enlistment contracts are for 3 years and up – our simplification is not overly severe, and will hold in more general setups as well.

As noted earlier, most youth who sign an enlistment contract do not ship directly to duty, but spend some period of time in the Delayed Entry Program (DEP), during which time they receive no information about *f*, but are subject to the random shocks $\varepsilon_d \sim N(0,\sigma_\varepsilon^2)$. Defining the DEP period as $t = 0$, individuals will attrite from DEP (that is, prior to entering service) if

$$G_0 = w^m - w^c + \tau^e + \varepsilon_d < 0.$$

More generally, attrition occurs in period t if

$$G_t^* + \varepsilon_t = w^m - w^c + \tau^e + \upsilon + \varepsilon_t < 0.$$

These assumptions imply a panel probit framework. Define the composite error in period t for individual i as $u_{it} = \tau_i + \varepsilon_{it}$. The correlation in across adjacent time periods of the u_{it} is

$$\rho = \frac{\sigma_\tau^2}{\sigma_\tau^2 + \sigma_\varepsilon^2}.$$

Given w^m and w^c, the pattern of in-service attrition is determined by ρ. Higher levels of σ_τ^2 (the variance of initial preferences) leads to higher initial, but more steeply declining rate of attrition in service as those with lower tastes τ depart.

Time in DEP: Job Market Search or Sorting?

This setup provides a clean test of the information updating hypothesis. Individuals with greater uncertainty, $\sigma_\tau^2 = \sigma_{\tau^e}^2 + \sigma_\upsilon^2$, should have higher rates of in-service attrition early on. It is reasonable to suppose that youth who enter military service directly should have higher σ_τ^2 (lower ρ) because random shocks experienced by youth who enter DEP prior to shipping to duty will cause those with lower forecasted preferences to drop out prior to entering service.

DEP attrition might also be explained within the framework of job search theory, with those spending time in DEP continuing to search for more attractive civilian wage offers. But if attrition from DEP were simply a matter of job search, and civilian wage offers are uncorrelated with τ or υ, in-service attrition and DEP attrition would be independent of one another; the preference distributions of those who ship directly to duty would be precisely the same as those who do not. If, in fact, one finds lower in-service attrition among those who spend time in DEP, this suggests that a sorting on preferences of the kind outlined here is taking place.

Simulations

A simulation exercise illustrates the main ideas. Parameter values were chosen so that the model delivers predicted rates of enlistment in the youth population and rates of DEP and in-service attrition that are of the same order of magnitude as the actual values. Each simulation starts with a cohort of 100,000 youth in the civilian labor market, tracking them through the enlistment decision, the DEP period, and three in-service periods. The preference factor at the time of contract (τ^e) was assumed to be normally distributed with mean $\mu_{\tau^e} = -10$, meaning that military service is more arduous, on average, than civilian employment for the typical youth, and standard deviation $\sigma_{\tau^e} = 10$.

The simulation results are contained in **Table 1.** In the first simulation, w_m=w_c=100, μ_υ = 0, and σ_υ= σ_ε = 5. As can be seen, 15 percent of youth sign an enlistment contract.[3] Among those who sign a contract, 15 percent draw a sufficiently negative value of ε_d to attrite from DEP and hence never enter military service. Among those who enter service, 26 percent separate after one period, 15 percent after the 2nd, and 11 percent after the 3rd period.

In general, attrition is highest early on, and declines with time as those with negative taste shocks depart, leaving those with high tastes for military service choosing to remain. The evolution of tastes is shown in **Figure 1** shows the evolution of tastes. Due to updating shocks that are drawn from a normal distribution, the distribution of tastes in the first service period (*new_tau_1* in Figure 1) is approximately normal despite the fact that the distribution of τ^e among joiners is a truncated normal (*DEP_tau*).[4] The taste distributions in periods 2 and 3 become more skewed as those with lower tastes leave at a higher rate than those with more positive tastes.

The second row of **Table 1** shows the effect of increasing the degree of uncertainty, σ_υ, from 5 to 10. By definition in our setup, the fraction signing an enlistment contract is unchanged.

[3] The 16 percent join rate is somewhat higher than the actual rate, but of the right order of magnitude. Annual accessions (roughly 200,000) are equal to about 10 percent of the number of males turning 18 years old each year.
[4] See Hosek and Mattock (2003) for a similar result. They derive an approximately normal distribution of preferences among entrants from an extreme-valued distribution of preferences in the youth population. But in their model, preferences are known with certainty and not subject to updating. The near normality of the updated preference τ permits application of the panel probit technique to in-service retention decisions.

However, this mean-preserving increase in uncertainty increases the possibility of both large positive and large negative in-service shocks. Because of the higher likelihood of large negative shocks, first period attrition increases. However, because of the larger variance in updating shocks, some recruits get draws that make them more likely to stay later. As a result, unless there is some bias in preference forecasting such that the mean update shock is non-zero for those who are also subject to larger update variance, attrition in the second and third periods can actually be smaller for the group with larger update shocks.

Explaining Variation in DEP and In-Service Attrition

Education. The simulations can aid in understanding variation in attrition across individuals with different levels of education and other attributes. For example, despite better civilian alternatives than dropouts or GED holders, high school graduates have lower rates of DEP and in-service attrition. The simulations suggest why. First, as suggested by a comparison of Rows 1 and 3 of **Table 1**, enlistees with a high school degree or better will have better civilian alternatives and will be less likely to sign an enlistment contract. If opportunity cost were the whole story, we would expect to see *higher* DEP and in-service attrition among better-educated individuals, not lower. However, if better-educated individuals are better informed at the time of enlistment about the level of effort required to successfully carry out military tasks, that is, have lower values of σ_{υ}, they are less likely to be surprised by a large negative preference update and hence less likely to attrite while in service.[5]

Race and Gender. Relative military pay ($w^m - w^c$) is likely to be higher for nonwhites than for whites, thus implying higher rates of enlistment, and (assuming that they are no better or worse informed about the conditions of service), lower rates of DEP and in-service attrition. One might expect the same to be true for women, but their attrition both in DEP and in service, is

[5] Another explanation is that effort costs are related (unobserved) individual ability, which reduces the effort required to get a high school degree as well as the effort required to fulfill military tasks. More able recruits, who tend to have better educations, are less likely to be unpleasantly surprised by military effort requirements.

much *higher* than that of men; the puzzle can be resolved if σ_{υ} is higher for women than men, a testable hypothesis.

The State of the Recruiting Effort. We alluded above to the possibility that youths' initial forecasts of the non-pecuniary aspects of military life might be biased, and result in systematically negative update shocks (μ_{υ}). This could arise, for example, if military recruiters, who face substantial pressure to meet their recruiting goals, paint a rosier picture of military life than actually exists in order to entice prospects to sign enlistment contracts. (Recall the movie *Private Benjamin*, when Goldie Hawn gets to boot camp and asks where is the condo she was promised by her recruiter!) Such bias could be more pronounced during times of difficult recruiting (that is, low rates of civilian unemployment); indeed, we find that in-service attrition is inversely related to the civilian unemployment rate.

Other Factors. To foreshadow two other results, we find that attrition is lower among recruits from states that have a higher concentration of veterans but is higher among recruits from states with higher family incomes. The veteran effect is consistent with the notion that both initial preference forecasts are positively affected, and uncertainty negatively affected, by exposure to veterans. Higher attrition of recruits from higher-income areas is consistent with the hypothesis that recruits from such areas have better civilian alternatives, making their attrition more likely. It is also consistent with the hypothesis that recruiters who are assigned to higher-income areas may try to paint a rosier picture of military life to get prospects to sign contracts than do recruiters located in lower-income areas, causing systematically more negative update shocks among recruits from the higher-income areas.

EMPIRICAL ANALYSIS

Data

We studied attrition during the first two years of service in the Army and the Navy. Data were provided by the Defense Manpower Data Center (DMDC) and supplemented with service-specific data on receipt of initial enlistment incentives and other variables not available in the

DMDC data.[6] To assemble our data set, DMDC began with a database containing records of all enlistment contracts processed through the Military Entrance Processing Command (MEPCOM) during the period 1988-1998. Each contract in the MEPCOM file was matched to (1) an accession or DEP loss record for that individual and (2) each end-of-fiscal year DMDC Active Duty Master Personnel Edit File (ADMPEF) record for the individual beginning with the fiscal year of the contract through either separation or the end of FY 2004.[7]

Table 2 summarizes 2-year in-service attrition and survival rates in 6-month intervals. As can be seen, 73 percent of initial Army enlistees, and 71 percent of initial Navy enlistees remain after the first 2 years of service. Two important features can be gleaned. First, attrition during the first 6 months of service is nearly 3 times as high as during subsequent periods. Second, attrition in service is negatively related to time spent in DEP.

Empirical Strategy

We estimated panel probit models of attrition with normally distributed unobserved heterogeneity through (up to) 4 6-month periods.[8] As discussed earlier, panel probit incorporates explicitly the role of unobservable heterogeneity in sorting, and has been used, for example, by Daula and Moffitt (1995) to model military reenlistment.[9] For the purposes of comparison, we first present simple probit estimates of DEP and 2-year attrition. The simple probit models for DEP and 2-year in-service attrition are estimated with the full dataset -- almost 900,000 Army

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[6] Andi Dettner was the DMDC programmer who developed the primary database. We owe her a debt of gratitude for her painstaking and careful work on the database.

[7] Thus, individuals who signed an enlistment contract in FY 1988 can potentially appear on 17 end-of-fiscal year ADMPEFs, contracts signed during FY 1989 can appear on up to 16 ADMPEFs, and so forth.

[8] It is feasible, at least in principle, to allow the variance of the random error to vary as a function of time in the panel probit model, which might allow it to capture more accurately the time path of attrition.

[9] Predictions of attrition from panel probit are smoother than the actual time path, under-predicting attrition early on and over-predicting later on. In work not reported here, we estimated a semi-parametric exponential hazard model in which the baseline hazard was allowed to vary in each of the 4 6-month periods. The semi-parametric exponential model permits a flexible fitting of any given baseline hazard but as Lancaster (1979) long ago demonstrated, there is a tradeoff between the precision with which one can estimate the baseline hazards and the degree of unobserved heterogeneity. Relatively precise estimates of the ancillary parameter were obtained in the exponential hazard framework when the baseline hazard was restricted to be constant over the four six-month periods. Allowing the baseline hazard to vary across periods drove the estimated ancillary parameter to insignificance. Because of our focus on a structural interpretation of the estimation results, we focus on the panel probit estimates here. Other results are available on request.

contracts and 750,000 Navy contracts – while the panel probit models were estimated on a 1/3-random sample of entrants to reduce computing time.

All standard errors have been clustered at the state level. Clustering at the Army MOS or Navy Rating and Program level did not so increase the estimated standard errors on variables such as term length or enlistment incentives so as to render them insignificant. However, state-level characteristics can take on just 51 values; because the error term across individuals within a given state is likely to be correlated, clustering has a substantial impact on the estimated standard errors of these variables.

Simple Probit Estimates of DEP and Two-Year In-Service Attrition

Tables 3 and 4 contain simple probit estimates of DEP attrition and 2-year in-service attrition as a function of various individual attributes, economic characteristics of their state of residence, and characteristics of their enlistment (e.g, length of the enlistment term, receipt of enlistment incentives), family income and population density at the 3-digit Zip code level and a measure of the role of influencers in the form of percent veterans at the state level. We also included a measure of physical fitness in the form of the body mass index (BMI).

Education

DMDC places recruits into 13 education categories. We define high school diploma graduates (HSDGs) as the reference category, and show the estimated marginal effects relative to this group. For example, high school seniors were 2.4 percentage points more likely to enter the Army, and 3.0 percentage points more likely to enter the Navy than HSDGs, but attrition differences in service were minor.

GED Holders. Evidence suggests that GED holders are less motivated than HSDGs, and are nearly indistinguishable from high school dropouts (Cameron and Heckman, p. 16). Our estimates support this view. GED holders were 2.3 percent less likely to enter the Army and 4.1 percent less likely to enter the Navy, and were **15 percent** more likely to attrite during the first two years of service from the Army and Navy than otherwise comparable HSDGs. Because the probit equations control for AFQT – a variable that has statistically significant, but quantitatively small effects on attrition -- the estimated differences between GED holders and HSDGs are unlikely to be capturing psychometric effects. The poorer civilian labor market alternatives of GED relative to HSDGs should, other things equal, generate *lower* attrition; the fact that they display much higher attrition suggests strongly that GED holders face higher uncertainty than HSDGs about the relative value of a military career.

High School Dropouts. To see this last point, notice that non-GED, non-HSDGs were 4.1 percentage points less likely to enter the Army than HSDGs, and 4.6 percentage points less likely to enter the Navy. The in-service attrition rate differences were 13.4 percent (Army) and 15.1 percent (Navy), respectively, virtually the same as the GED-HSDG differences.

The DEP attrition probits suggest that GED holders are more stable than high-school degree near-completers – individuals with 12 years of education but no degree. For example, near completers had attrition rates in DEP 10.4 (Army) and 13.4 (Navy) percent higher than those of HSDGs. One might suspect that the DEP results may reflect demand-side factors; in particular, a youth may negotiate an enlistment contract that is contingent on earning a high school degree, a contract that may need to be renegotiated if the youth fails to earn the degree. However, attrition rates in service among near-completers were 10.1 and 13.3 percent higher in the Army and Navy than among HSDGs – a smaller differential than was observed for GED holders.

Non-HSDGs with one semester of college, classified as Tier 1, are about 10 percentage points more likely to attrite from either the Army or the Navy than HSDGs. This could reflect differences in either civilian labor market opportunities or taste uncertainty. College graduates, with unambiguously better civilian labor market opportunities than otherwise comparable high school graduates, are 2.3 percentage points more likely to enter the Army, but 2.2 percentage points *less* likely to enter the Navy. However, college graduates had 5 percentage point lower rates of in-service attrition than HSDGs from both Services. Because attrition in service is more likely, the higher the civilian-military wage differential, the evidence suggests that the taste shocks of college graduates are drawn from a distribution with a smaller variance than that of high school graduates.

Adult education seems to be a poor substitute for a high school degree. Enlistees with adult education are 8.4 percentage points more likely to attrite from the Army, and 10 percentage points more likely to attrite from the Navy.

Home schooling has become increasingly popular in the U.S. The Navy, in particular, has made an effort in recent years to attract such individuals. As can be seen, home schooled individuals were estimated to be 8-10 percentage points more likely to attrite than HSDGs. However, the effects for home schooled recruits cannot be estimated with much precision due to the relatively small numbers of such recruits.

Other Personal Characteristics

Women had far higher rates of DEP attrition than did their male counterparts in both services – 8.5 percentage points in the Army and 10.5 percent in the Navy. Two-year attrition was also 16.6 percentage points higher among women who enlisted in the Army. However, in the Navy attrition among women was only 2.4 percentage points higher. These large differences are consistent with the hypothesis of greater uncertainty about the conditions of service among women than men both prior to and after they enter service.

Recruits who were married at the time of the enlistment contract were 1.4 percentage points more likely than single recruits to enter the Army but were 1.7 percentage points less likely to enter the Navy. Married recruits had higher rates of in-service attrition in both the Army (2.0 percentage points) and Navy (1.4 percentage points).

Recruits with higher body mass indexes (BMI) were less likely to enter either the Army or the Navy, but the estimated effects were small. However, an increase in BMI does not appear to affect two-year attrition from the Navy while each 5-point increase in BMI is associated with a 2.0 percentage point increase in two-year attrition from the Army. These BMI response differentials may reflect differences in the physical demands placed on Army and Navy personnel within the same occupational categories.

Non-whites uniformly had lower rates of DEP and in-service attrition than their white counterparts. We estimate that for the Army all other race groups have about 10 percentage point lower two-year attrition than whites. These race group differences could be due to relatively poorer civilian economic alternatives for non-whites, but they could also be arising from differences in the degree of preference uncertainty prior to entry. In fact, evidence below indicates that some of these in-service attrition differences are arising from differences in preference shocks.

Higher AFQT scores were associated with higher Army DEP attrition, but the estimated effects are tiny. However, each 10-point increase in AFQT is associated with a 1 percentage point higher probability of completing two years of service in either the Army or the Navy.

Enlistment Term Length and Enlistment Incentives

Individuals who are willing to sign longer initial enlistment contracts probably have a greater mean and lower variance of tastes for military service, both of which lead one to expect a higher entry rate and a lower attrition rate for them. The effects of enlistment incentives, while reflecting their impact on the pecuniary returns to military service, will also reflect the distribution of underlying tastes. For example, for a recruit who receives a cash enlistment bonus or Army or Navy College Fund, the incentive may have been the decisive factor. To the extent that recipients tend to have lower average (or higher variance) tastes for military service than recruits who were willing to join without an incentive, the net correlation between attrition and receipt of an enlistment incentive is uncertain.

College benefits are unlike bonuses in one respect – recruits must successfully complete an enlistment to earn eligibility for such benefits. The college fund program may, therefore, induce recruits to self-select – a la Salop and Salop -- such that only recruits who (privately) know that they are more likely to complete an enlistment will opt for these benefits over an alternative enlistment incentive such as a bonus or an enlistment without an incentive.

We treat the results for Army and Navy separately because of differences in the way they awarded enlistment bonuses over the period. The Army has historically awarded enlistment bonuses for recruits who sign for as few as three years and college fund benefits to recruits who sign for as few as two years. For the Army, dummy variables for term of enlistment and enlistment incentives were entered separately as well as interacted with one another for every combination of term and incentive. (Due to the relatively small numbers of 5 and 6-year enlistments in the Army, we grouped them together for the purposes of this analysis.)

The Navy, by contrast, only offered a college fund benefit beginning in the early 1990s, and then only to four-year enlistees. NCF was later offered to a small number of 3-YO enlistees. Most of the Navy's enlistment bonus resources have been targeted to recruits who enlisted in 6-YO Nuclear Field, Advanced Electronics Field, Advanced Technical Field programs early on. Through the 1990s, the Navy enlistment bonus program was expanded to recruits who enlisted in 4-YO (School Guarantee) programs provided that they signed a one-year extension up front – that is, bonuses were targeted to 5 and 6-YOs. Because bonuses are targeted to 5 and 6-YO recruits, the bonus variable is not interacted with enlistment term length.

*Army***.** All effects were estimated relative to a four-year enlistment term. Army 2-YO enlistees were 1.5 percentage points less likely to enter the military, but were 3.4 percentage points less likely to attrite.[10] Although 3-YO Army enlistees were 0.6 percentage points more likely to enter, they were slightly (0.5 percentage points) more likely to attrite in service than four-year recruits. At the longer end, 5 and 6-YO Army recruits were 1 percentage point more likely to enter service but 0.4 percent more likely to attrite in service. Again, relative to a four-year term, the net effect is a higher likelihood of entering and completing two years of service.

Army 4-YO recruits who received enlistment bonuses were significantly more likely (1.8 percentage points) to enter service, but were 2 percentage points less likely to complete two years of service. On net, then, this suggests that there is some adverse selection in the award of Army enlistment bonuses. The Army did not offer bonuses to 2-YO recruits. As can be seen, 3-YO recruits who received an enlistment bonus were significantly less likely (-2.7 = 1.8 – 4.5

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[10] Because the last several months of a 2-year enlistment spans the reenlistment window, 2YOs were coded as attriters only if their time in service was less than 21 months.

percentage points) to enter military service, and were more likely (2.7 percentage points) to attrite while in service. The more negative effects of bonuses on entry of 3-YOs than entry of recruits who signed for longer terms may reflect a greater degree of initial preference uncertainty among such recruits. The estimated attrition differences between 4-YO and 5 and 6-YO enlistment bonus recipients were statistically significant but small in magnitude.

Recipients of Army College Fund who enlisted for four years were 3 percentage points more likely to enter military service and 0.9 percentage points less likely to attrite while in service. At other enlistment terms, ACF recipients were also more likely to enter than non-ACF recipients, but the differences were smaller than with 4-YOs. But the in-service attrition of both 2-YO and 3-YO ACF recipients was significant lower than the attrition of non-recipients of the same term length (over 4 percentage points in both cases).

Navy. As pointed out, the effects of term enlistment length and enlistment bonuses are virtually inextricably linked; nearly all 5-YO recruits have been enticed to sign a one-year contract extension up front by the offer of an enlistment bonus. Adding the two effects (-1.2 + 2.7 = 1.5 percentage points), we see that 5-YO recruits have lower DEP attrition than 4-YO recruits who receive no bonus or college fund benefits. Furthermore, 5-YO recruits have 3.5 percentage points lower attrition in service.

Not all Navy 6-YO recruits receive enlistment bonuses or college fund benefits. DEP attrition among 6-YO EB non-recipients is about the same as that of 4-YOs, but 6-YO in-service attrition is significantly lower (by 4.2 percentage points). The net effect, then, is a much higher likelihood that an individual who signs an enlistment contract for six years will complete two years of service. Navy 6-YOs who receive enlistment bonuses – those who enlist in a nuclear field, as well as many who enlist in other technical programs (AEF, ATF, and AEC) are predicted to have 2.4 (= 0.7 + 1.7) percentage points lower DEP attrition than 6-YO non-recipients; but two-year attrition difference is small (-0.3 = - 6.1 + 5.8).

State and Zipcode-Level Economic and Social Characteristics

In absence of information on family background characteristics, a number of state-level economic and social characteristics were entered as controls. As already noted, the standard errors have been clustered at the state level in order to account for possible spatial dependence of the error term.

In previous research, we have found high-quality enlistment supply to be positively related to the percentage of veterans in each state's male population age 35 and over (Warner, Simon, and Payne, 2003), a variable that we interpret as measuring the role of influencers on the enlistment decision. Our results indicate that, as expected, both DEP and in-service attrition to be lower for recruits who lived in states with higher concentrations of military veterans. Each 10 percentage-point increase in the concentration of veterans is associated with 1 percentage point lower DEP attrition and 2 percentage points lower in-service attrition from either service.

Also as one might expect, youth from states with higher population densities and higher average family incomes, who presumably have better civilian alternatives, had higher rates of DEP and in-service attrition, although the estimated effects of population density were not always statistically significant. We also found the likelihood of entry to be positively related, and two-year in-service attrition to be negatively related, to the percentage of a state's 17-21 year-old high school graduate (or better) population that is enrolled in college. A 10 percentage point increase in the college enrollment rate is estimated to increase the likelihood of entry by 1 percentage point and reduce the likelihood of in-service attrition by 2 percentage points. The may signal that youth who live in states with more opportunities for college attendance and who are still willing to enter service have a higher average taste for service than youth entering from states where college opportunities are poorer.

Dynamic Models of In-Service Attrition: Panel Probit Estimates

As discussed above, the panel probit model permits one to estimate the degree of preference heterogeneity among recruits who enter service. Recall from the above discussion that because the shock to individual i's attrition decision in period t is in period t is $u_{it} = \tau_i + \varepsilon_{it}$ and the correlation between shocks across time periods is $\rho = \sigma_\tau^2 / (\sigma_\tau^2 + \sigma_\varepsilon^2)$, where ρ measures the heterogeneity in updated preferences of recruits who actually enter service. We hypothesize that the degree of preference heterogeneity will be smaller among those who enter DEP, and remain longer in it, than among recruits who ship directly to duty. Further, if the variance of the updating shocks are larger for some demographic groups than others, then σ_{τ}^{2} and thus ρ will vary systematically by demographic group. We attempt to discover preference updating in three steps by: (1) estimating a single panel probit model and obtaining a single estimate of ρ for each service, then (2) estimating the model by DEP group and observing whether ρ varies by DEP group as our theory suggests, and then (3) estimating separate models disaggregated by DEP group and demographic attribute (education level, gender, and race) and studying the pattern of ρ estimates.

Table 5 shows estimates of a pooled panel probit model for each service. The estimate of ρ for the Army is 0.262; the estimate for the Navy is 0.499. Both estimates are statistically significant and indicative of preference heterogeneity. The models include dummy variables for the two longer DEP times (5-21 weeks and more than 21 weeks, respectively). The estimates indicate a lower per-period attrition hazard for groups with longer DEP times. And consistent with the simple probit estimates for two-year attrition, better educated groups have lower attrition risk, as do blacks and Hispanics. Again, females have a higher attrition risk, but the quantitative difference between the genders is much bigger for the Army.

As an initial test, we estimated the model by DEP group (Tables A-1 and A-2). As can be seen, the estimates of ρ do in fact tend to be smaller for recruits who spent longer times in DEP. For example, the estimated values of ρ were 0.500, 0.442, and 0.261 for Navy recruits who spent 0-4 weeks, 5-21 weeks, and more than 21 weeks in DEP, respectively. The estimated values for the Army estimates were 0.357, 0.359, and 0.136. Only the differences between these groups and the longest DEP group are statistically significant, but the results are generally consistent with the information hypothesis.

Estimated effects of education, race, and gender are reasonably stable across DEP groups in these models. Because these models restrict the degree of heterogeneity to be the same within

DEP group, though, the demographic and other variables can, in principle, reflect the influence of both differences in the variance of tastes as well as mean tastes.

Although we could, in principle, estimate the panel probit model separately for an arbitrarily large number of groups, considerations of computational (time) cost as well as questions of theoretical relevance led us to divide the data into a relatively small number of groups according to education, race, gender, and, of course, time in DEP. There are 2 education groups: high (high school seniors, HSDGs, and 2- and 4-year college degree recipients) and low (dropouts, GED recipients, and so on); and 2 race groups (whites and non-whites). There are therefore 24 estimates of ρ (2 education groups x 2 race groups x 2 genders x 3 DEP groups) for each Service.

Table 6 contains regressions of $\hat{\rho}$ on group characteristics and, in the pooled model, a service dummy. Observations in each model are weighted by group size; t-statistics are based on robust standard errors. Nearly all of the variation in $\hat{\rho}$ is explained by the group dummies. Consistent with the results above, $\hat{\rho}$ declines with time in DEP. Furthermore, it is smaller for those with high education, males (in the Army), and non-whites. These estimates imply less variation in update shocks (i.e., smaller σ_υ) for these groups. Stated alternatively, the regressions in **Table 6** are consistent with the view that groups that have high early in-service attrition do so because they are subject to greater preference uncertainty prior to entry into military service.

Attrition differences may arise from differences in mean (updated) tastes or mean civilian opportunities as well as differences in taste heterogeneity. Differences in mean updated tastes or opportunities will be revealed as differences in intercepts by education-race-gender-DEP group. More positive tastes will be revealed as more negative intercepts in the panel probits. Table 7 thus contains regressions similar to those in Table 6, but with the panel probit intercepts as the dependent variable. There is little evidence of mean differences by DEP group in the Army, but direct ships in the Navy have significantly lower mean taste than the two longer DEP groups. Males have higher mean tastes in both the Army and Navy, as do the more educated. Racial differences are found in the Army, where mean tastes are estimated to be higher for non-whites, but not in the Navy. The latter finding suggests that all of the racial differences in attrition found for the Navy in the simple probit and pooled panel probit models are due to unobserved heterogeneity.

Without more information, it is not possible to identify the source of these intercept differences. We speculated earlier that if some groups' initial forecasts of the non-pecuniary aspects of military life were too optimistic, their mean update shock (μ_υ) would be systematically negative. Interpreted in this way, the results suggest that less-educated recruits and female recruits are more likely to underestimate the difficulty of military life (e.g., military effort requirements).

Figures 2 through **4** display predicted attrition for selected demographic groups based on the disaggregated panel probit estimates. The key to understanding these figures is that differences in mean tastes or opportunity costs will be manifested as proportional shifts in the attrition functions, while differences in the variance of tastes – that is, differences in $\hat{\rho}$ -- take the form of disproportionate changes in the slope of the attrition function. Consider, for example, the predicted attrition paths in **Figure 2** for low- and high-education nonwhite women in the Army. Because of their higher degree of taste heterogeneity, predicted attrition for the low-education group starts out higher, but declines at a faster rate, than for the high-education group. The figure also illustrates differences in attrition by gender and race.

Figures 3 and **4** show the differences in predicted attrition by DEP category. **Figure 3** contrasts Army recruits who spent less than 5 weeks in DEP with comparable recruits who spent more than 21 weeks in DEP. The low DEP-time group has higher early attrition, but its attrition declines more rapidly due to its greater degree of taste heterogeneity. **Figure 4** shows the same pattern for the Navy, as well as showing the lower degree of heterogeneity, and hence lower attrition rate, among nonwhites who spent less than 5 weeks in DEP. Interestingly, there is virtually no racial difference in predicted attrition among recruits who spent more than 21 weeks in DEP.

CONCLUSION

This paper has modeled first-term enlisted attrition as the outcome of a process of learning about true tastes for service. Attrition occurs when recruits learn that their true tastes for service are sufficiently lower than forecasted tastes to render the gain to staying negative. Preference shocks might arise from different sources, but in our view (model) they arise when youth are ill-informed about the actual on-the-job effort requirement and (optimistically) understate this requirement prior to entry. Larger mistakes in forecasting the effort requirement leads to higher early attrition, but a steeper decline in attrition relative to the better informed groups.

The empirical analysis provided evidence supporting this view of the attrition process. More educated groups, males, and non-whites are estimated to have lower, flatter attrition profiles, a result consistent with the model. The model also explains the empirical finding of lower and flatter attrition profiles for individuals who entered and remained longer in DEP.

This last result has important implications for current military manpower policy. The length and lethality of the second Iraq war has strained the existing force, the Army in particular, which along with the Marine Corps has borne the brunt of the conflict. As public support for the mission in Iraq has declined, the Army has missed its recruiting targets in recent months. In response, the Army has reduced the time that newly signed recruits spend in the DEP in order to place them in service more quickly. In addition to reducing the pipeline of future manpower supply, our empirical results suggest that the result will also entail higher attrition in service. The Army recognizes the problem and has adjusted basic training to reduce attrition.[11] It remains to be seen whether this adjustment in training policies reduces attrition longer term.

[11] See "To Keep Recruits, Boot Camp Gets a Gentle Revamp," The Wall Street Journal, February 15, 2006, p. A1. Less harassment by drill instructors, more counseling for those at high risk for attrition, and shorter marches are among the changes the Army has implemented to reduce boot camp attrition. The report says that 6-month attrition has fallen from 18 percent in 2004 to 11 percent more recently as a result of these policies. Notice that the 18 percent 6-month attrition rate for 2004 is considerably higher than the 14.2 percent rate for FY 1988-98 Army entrants reported in Table 2.

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Table 1. Simulations of DEP Attrition and In-Service Attrition

Parameter Values			% Join	% Attrition in Period			
w^m	***w^c***	***σ_u***		***DEP***	***1***	***2***	***3***
100	100	5	15	15	26	15	11
100	100	10	15	15	32	13	8
100	110	5	6	17	28	16	13

Note: $\mu_{\tau^e} = -10$ and $\sigma_{\tau^e} = 10$

Table 2. In-Service Attrition and Survival

	Attrition				Survival			
A. Army		DEP Group				DEP Group		
	All	1	2	3	All	1	2	3
0-6 Months Svc	0.142	0.159	0.148	0.119	0.858	0.841	0.852	0.881
7-12 Months Svc	0.049	0.053	0.050	0.044	0.816	0.796	0.809	0.842
13-18 Months Svc	0.053	0.067	0.055	0.038	0.773	0.743	0.765	0.810
19-24 Months Svc	0.056	0.065	0.055	0.050	0.729	0.695	0.723	0.770
B. Navy								
0-6 Months Svc	0.156	0.195	0.162	0.126	0.844	0.805	0.838	0.874
7-12 Months Svc	0.057	0.072	0.057	0.048	0.796	0.747	0.790	0.832
13-18 Months Svc	0.055	0.073	0.056	0.043	0.752	0.693	0.746	0.796
19-24 Months Svc	0.059	0.074	0.058	0.051	0.708	0.641	0.703	0.756

Note: DEP Group 1: <5 weeks; DEP Group 2: 5-21 weeks; DEP Group 3: >21 weeks.

Table 3. Simple Probit Estimates: Army Contracts, FY 1988-98

Independent Variable	Entered the Army? Marginal Effect	z	Variable Mean	Attrited In First Two Years? Marginal Effect	z	Variable Mean
Economy Wide Pecuniary Factors						
Relative Military Pay	0.006	0.26	1.050	-0.010	-0.27	1.04967
Unemployment Rate	0.005	4.03	5.896	-0.002	-1.35	5.92316
Education (Omitted: Tier 1 HS Diploma Grad)						
Tier 1 In-High School	0.024	5.31	0.321	-0.003	-1.18	0.292
Tier 1 Adult Ed	0.006	1.25	0.007	0.084	6.14	0.007
Tier 1 One Sem Coll	0.000	-0.14	0.016	0.099	13.22	0.017
Tier 1 Associate Deg	0.023	5.51	0.008	-0.041	-7.21	0.008
Tier 1 College Degree	0.023	6.82	0.022	-0.050	-8.59	0.022
Tier 2 HS Attend Cert	0.023	0.89	0.000	-0.012	-0.21	0.000
Tier 2 Occ Cert	0.014	0.49	0.000	-0.007	-0.21	0.000
Tier 2 Corresp Cert	0.066	1.02	0.000	0.154	1.75	0.000
Tier 2 Home Schooler	0.027	0.49	0.000	0.087	2.23	0.000
Tier 2 GED	-0.023	-8.64	0.045	0.154	38.03	0.047
Tier 2 Near Completion	-0.104	-12.66	0.008	0.101	10.10	0.007
Tier 3 Non-HSG	-0.041	-7.82	0.013	0.134	16.10	0.013
Personal Characteristics						
AFQT	0.000	-4.52	59.305	-0.001	-22.54	59.223
Male	0.085	30.39	0.818	-0.166	-59.06	0.831
Black	0.012	3.02	0.232	-0.087	-13.25	0.234
Hispanic	0.009	2.78	0.064	-0.100	-16.89	0.064
Other	0.011	4.08	0.036	-0.070	-11.07	0.036
Married	0.014	8.64	0.094	0.020	7.38	0.097
Contract Age	-0.004	-11.35	20.046	0.001	1.94	20.116
Body Mass Index	0.000	-1.65	24.706	0.004	22.70	24.748
Time in DEP						
Predicted DEP Time	-0.006	-34.42	18.147			
5-21 Weeks in DEP				-0.019	-8.08	0.409
>21 Weeks in DEP				-0.037	-15.18	0.306
Enlistment Term Length (Omitted: 4-YO)						
2-YO	-0.015	-3.52	0.084	-0.034	-7.95	0.082
3-YO	0.006	2.84	0.278	0.005	3.04	0.279
5 or 6-YO	0.010	4.60	0.120	0.004	2.38	0.119
Enlistment Incentives						
Bonus	0.018	7.39	0.112	0.020	11.31	0.114
Bonus*3-YO	-0.045	-14.34	0.009	0.007	1.25	0.009
Bonus*5 or 6-YO	-0.007	-2.08	0.017	0.000	-0.06	0.017
Army College Fund (ACF)	0.030	11.05	0.225	-0.009	-5.39	0.224
ACF*2-YO	-0.014	-3.36	0.065	-0.040	-8.35	0.064
ACF*3-YO	-0.026	-9.26	0.072	-0.035	-9.29	0.071
ACF*5 or 6-YO	-0.023	-3.63	0.003	0.011	1.13	0.003
State and Zipcode-Level Characteristics						

Percent Youth in College	0.001	2.82	61.204	-0.002	-3.32	61.181
Male Vet Pop (% age 35+)	0.001	3.42	41.460	-0.002	-3.02	41.551
Population Density (3-digit Zip)	-0.002	-1.67	0.626	0.002	1.00	0.624
Family Income (3-digit Zip)	-0.006	-4.92	4.100	0.005	3.55	4.095
Military Occupation Group (Omitted: Administrative)						
Combat Arms	-0.001	-0.70	0.303	0.037	20.50	0.307
Electronics Equipment Repair	0.005	2.54	0.054	0.014	4.58	0.054
Communications & Intelligence	0.004	2.02	0.137	0.005	2.52	0.137
Medical	0.007	4.23	0.075	-0.005	-2.06	0.074
Other Technical	0.005	1.46	0.027	0.003	0.92	0.027
Administrative	-0.006	-3.34	0.147	-0.002	-1.04	0.148
Electrical/Mechanical Equip	-0.012	-5.67	0.020	0.030	7.24	0.020
Craftsmen	-0.005	-3.15	0.125	0.029	14.70	0.124
Fiscal Year Interval (Omitted = FY 1988-89)						
FY 1990-93	-0.008	-3.87	0.357	0.062	18.19	0.363
FY 1994-96	-0.025	-5.80	0.241	0.074	10.41	0.235
FY 1997-98	-0.036	-5.12	0.175	0.070	7.61	0.169
Number of Observations	882,872			747,812		
Log-Likelihood	-360,691			-418,564		
Dependent Variable Mean	0.847			0.270		

Note: Standard errors clustered on state.

Table 4. Simple Probit Estimates: Navy Contracts, FY 1988-98

Independent Variable	Entered the Navy? Marginal Effect	z	Variable Mean	Attrited In First Two Years? Marginal Effect	z	Variable Mean
Economy Wide Pecuniary Factors						
Relative Military Pay	-0.011	-0.59	1.046	-0.011	-0.37	1.046
Unemployment Rate	0.005	3.95	5.920	-0.006	-3.77	5.927
Education (Omitted: Tier 1 HS Diploma Grad)						
Tier 1 In-High School	0.030	10.34	0.369	-0.005	-2.16	0.345
Tier 1 Adult Ed	-0.017	-2.76	0.013	0.103	19.61	0.013
Tier 1 One Sem Coll	-0.009	-2.14	0.013	0.099	12.26	0.014
Tier 1 Associate Deg	0.006	0.79	0.006	-0.050	-4.46	0.006
Tier 1 College Degree	-0.022	-4.22	0.010	-0.055	-5.14	0.010
Tier 2 HS Attend Cert	0.010	0.53	0.001	0.105	5.54	0.001
Tier 2 Occ Cert	-0.007	-0.19	0.000	0.027	0.50	0.000
Tier 2 Corresp Cert	-0.055	-0.79	0.000	0.148	1.45	0.000
Tier 2 Home Schooler	-0.024	-0.75	0.000	0.100	1.89	0.000
Tier 2 GED	-0.041	-9.35	0.029	0.148	27.88	0.031
Tier 2 Near Completion	-0.134	-20.19	0.019	0.133	18.21	0.015
Tier 3 Non-HSG	-0.046	-8.74	0.024	0.151	22.92	0.025
Personal Characteristics						
AFQT	0.000	1.06	57.164	-0.001	-8.75	57.195
Male	0.105	38.84	0.829	-0.024	-9.99	0.844
Black	0.017	4.48	0.210	-0.045	-6.22	0.213
Hispanic	-0.001	-0.36	0.087	-0.038	-3.50	0.086
Other	0.009	2.21	0.063	-0.070	-4.06	0.064
Married	-0.007	-3.02	0.040	0.014	2.71	0.040
Contract Age	-0.003	-15.74	19.757	0.004	6.05	19.810
Body Mass Index	-0.001	-4.74	24.469	0.000	-0.31	24.478
Time in DEP						
Predicted DEP Time	-0.006	-40.43	21.803			
5-21 Weeks in DEP				-0.051	-35.51	0.289
>21 Weeks in DEP				-0.088	-33.41	0.428
Enlistment Term Length (Omitted: 4-YO)						
3-YO	-0.017	-9.54	0.127	-0.013	-5.63	0.129
5-YO	-0.012	-5.21	0.092	-0.035	-8.62	0.089
6-YO	0.003	1.64	0.118	-0.042	-14.23	0.121
Enlistment Incentives						
Bonus	0.027	12.29	0.059	-0.001	-0.33	0.061
Navy College Fund (NCF)	0.007	2.91	0.077	-0.061	-19.18	0.077
NCF*3-YO	-0.005	-0.65	0.007	0.028	3.38	0.007
NCF*5-YO	0.027	3.70	0.004	0.036	3.17	0.004
NCF*6-YO	0.017	3.77	0.015	0.058	10.28	0.015
State and Zipcode-Level Characteristics						
Percent Youth in College	0.001	3.12	61.353	-0.002	-5.00	61.350

Male Vet Pop (% age 35+)	0.001	3.81	41.620	-0.002	-4.52	41.652
Population Density (3-digit Zip)	-0.001	-1.49	0.716	0.000	0.15	0.720
Family Income (3-digit Zip)	-0.004	-3.58	4.156	0.005	3.22	4.154
Military Occupation Group (Omitted: Administrative)						
Combat Arms	0.007	2.41	0.267	-0.031	-8.98	0.273
Electronics Equipment Repair	0.012	5.39	0.197	-0.030	-9.92	0.200
Communications & Intelligence	0.018	7.31	0.100	-0.043	-15.68	0.101
Medical	0.021	9.14	0.075	-0.078	-25.24	0.073
Other Technical	0.034	6.63	0.007	-0.063	-7.90	0.007
Electrical/Mechanical Equip	0.003	1.38	0.199	-0.017	-4.90	0.195
Craftsmen	-0.003	-0.93	0.050	-0.029	-5.63	0.048
Supply & Service Handlers	-0.011	-4.15	0.042	0.028	6.90	0.042
Fiscal Year Interval (Omitted = FY 1988-89)						
FY 1990-93	0.014	6.17	0.349	0.066	19.17	0.348
FY 1994-96	0.011	3.11	0.241	0.097	14.45	0.241
FY 1997-98	0.000	0.00	0.151	0.052	5.44	0.149
Number of Observations	619,803			520,990		
Log-Likelihood	-261,015			-307,292		
Dependent Variable Mean	0.840			0.294		

Note: Standard errors clustered on state.

Table 5:
Panel Probit Estimates of Army and Navy Attrition Using the Full Samples

	Army		Navy	
	Parm Est	**Std Error**	**Parm Est**	**Std Error**
Time in DEP:				
5-21 Weeks	-0.070	-10.66	-0.184	-17.80
>21 Weeks	-0.132	-14.32	-0.313	-26.46
Economy Wide Pecuniary Factors (Time of Contract)				
Rel Mil Pay	0.043	0.94	-0.150	-2.24
Unemp Rate	-0.010	-4.71	-0.020	-6.32
Education (Omitted: Tier 1 HS Diploma Grad)				
Tier 1 in HS	-0.005	-0.57	-0.023	-2.02
Tier 1 Adult Ed	0.191	6.39	0.305	9.57
Tier 1 One Sem Coll	0.271	14.02	0.284	8.97
Tier 1 Assoc Deg	-0.133	-4.35	-0.247	-4.79
Tier 1 College Deg	-0.097	-5.05	-0.196	-4.73
Tier 2 GED	0.392	32.18	0.482	22.87
Tier 2 Near Complete	0.279	9.69	0.415	13.48
Tier 2 HS Attendance			0.328	2.97
Tier 3 Non-HSG	0.329	14.92	0.483	20.19
Personal Characteristics				
AFQT Score	-0.004	-22.21	-0.003	-11.92
Male	-0.447	-60.42	-0.079	-7.33
Black	-0.303	-42.48	-0.189	-17.70
Hispanic	-0.338	-28.28	-0.154	-10.31
Other	-0.266	-17.69	-0.289	-16.57
Contract Age	0.008	7.25	0.018	10.58
Married at Contract	0.049	5.13	0.062	3.11
Body Mass Index	0.006	19.78	0.001	0.84
Enlistment Term Length (Omitted: 4-YO)				
Two Yr Contract	-0.021	-0.94		
Three Yr Contract	0.036	4.41	-0.030	-2.28
Five Yr Contract	0.005	0.44	-0.121	-7.25
Six Yr Contract	-0.017	-1.28	-0.140	-8.93
Enlistment Incentives				
Bonus	0.049	4.73	-0.030	-1.53
College Fund	-0.034	-3.07	-0.193	-11.98
Bonus*3-YO	-0.007	-0.26		
Bonus*5 or 6-YO	0.037	1.57		
ACF*2-YO	-0.093	-3.54		
ACF*3-YO	-0.141	-9.13		
ACF*5 or 6-YO	0.052	1.11		
State and Zipcode-Level Characteristics				
Percent College	-0.005	-6.67	-0.009	-8.70
Veteran Percent	-0.005	-5.97	-0.007	-5.98
Population Density	0.005	3.15	0.005	2.50

Family Income	0.020	6.57	0.017	4.00
Military Occupation Group (Omitted: Administrative)				
Combat Arms	0.077	7.95	-0.169	-9.34
Electronics	0.050	3.61	-0.153	-8.29
Communications	-0.012	-1.14	-0.225	-11.23
Medical	-0.038	-3.06	-0.360	-15.83
Other Technical	-0.001	-0.06	-0.263	-5.14
Elect Equip Repair	-0.024	-2.24	-0.084	-4.64
Craftsman	0.078	3.89	-0.158	-6.48
Supply & Service	0.074	6.96	0.042	1.75
Fiscal Year Group (Omitted: FY 1988-89)				
FY 1990-1993	0.220	27.08	0.246	21.53
FY 1994-1996	0.221	21.48	0.379	25.43
FY 1997-1998	0.209	17.17	0.267	14.32
Intercept	-0.894	-9.73	-0.554	-4.03
ρ	0.262		0.499	
σ^2_t	0.595		0.998	
Sample Size	235,776		173,869	
Log-likelihood	-214,163.7		-165,744.6	

Table 6. Regression of $\hat{\rho}$ on Group Characteristics

	Pooled		Army		Navy	
	Parm Est	t-Stat	Parm Est	t-Stat	Parm Est	t-Stat
Dep Group 1	0.582	13.64	0.508	11.31	0.545	11.42
DEP Group 2	0.546	12.36	0.482	9.45	0.491	10.44
DEP Group 3	0.374	8.26	0.295	4.32	0.323	5.96
High Education	-0.102	-4.24	-0.111	-3.87	-0.090	-2.55
Male	-0.154	-4.60	-0.242	-7.17	-0.053	-1.77
White	0.156	5.25	0.226	8.37	0.090	3.56
Army	-0.102	-4.34				
Standard Error	0.067		0.054		0.047	
R^2	0.972		0.981		0.989	
Sample Size	47		23[a]		24	

Notes:
t-statistics based on robust standard errors; regressions weighted by sample size.
[a]Equation contains 23 observations because panel probit model for high education, non-white, males in DEP group 3 would not converge.

Table 7. Regression of Intercept Estimates on Group Characteristics

	Pooled		Army		Navy	
	Parm Est	t-Stat	Parm Est	t-Stat	Parm Est	t-Stat
Dep Group 1	-1.161	-12.43	-1.474	-15.98	-0.884	-7.48
DEP Group 2	-1.303	-14.01	-1.512	-14.93	-1.164	-11.08
DEP Group 3	-1.300	-12.22	-1.554	-12.6	-1.111	-9.45
High Education	-0.309	-4.93	-0.223	-3.31	-0.402	-7.17
Male	-0.203	-3.98	-0.208	-3.93	-0.212	-2.77
White	0.091	1.65	0.219	4.51	-0.055	-0.90
Army	-0.087	-1.41				
Standard Error	0.171		0.179		0.127	
R^2	0.992		0.992		0.992	
Sample Size	47		23		24	

Notes:
t-statistics based on robust standard errors; regressions weighted by sample size.
[a]Equation contains 23 observations because panel probit model for high education, non-white, males in DEP group 3 would not converge.

Appendix A: Panel Probit Estimates by DEP Group

Table A-1. Army Panel Probit Estimates Through First Two Years of Service

Variable	DEP Group 1 Coeff	DEP Group 1 z	DEP Group 2 Coeff	DEP Group 2 z	DEP Group 3 Coeff	DEP Group 3 z
Economy Wide Pecuniary Factors (Time of Contract)						
Rel Mil Pay	-0.199	-2.1	0.007	0.1	0.258	3.4
Unemp Rate	-0.015	-3.3	-0.015	-4.1	0.006	1.6
Education (Omitted: Tier 1 HS Diploma Grad)						
Tier 1 in HS	0.071	2.1	-0.009	-0.6	0.015	1.1
Tier 1 Adult Ed	0.220	4.2	0.223	4.8	0.095	1.0
Tier 1 One Sem Coll	0.286	8.3	0.304	9.9	0.276	5.3
Tier 1 Assoc Deg	-0.144	-2.3	-0.165	-3.5	-0.188	-2.5
Tier 1 College Deg	-0.194	-4.7	-0.262	-8.4	-0.256	-5.3
Tier 2 GED	0.429	20.8	0.441	21.5	0.425	9.4
Tier 2 Near Complete	0.190	2.1	0.309	7.3	0.301	6.4
Tier 3 Non-HSG	0.447	11.8	0.375	9.1	0.108	2.3
Personal Characteristics						
AFQT Score	-0.005	-14.2	-0.005	-17.3	-0.003	-10.5
Male	-0.531	-33.1	-0.511	-41.0	-0.395	-30.0
Black	-0.374	-25.8	-0.341	-27.8	-0.226	-18.0
Hispanic	-0.423	-16.8	-0.383	-19.0	-0.255	-12.5
Other	-0.294	-9.5	-0.327	-13.0	-0.198	-7.3
Contract Age	0.007	3.3	0.009	4.8	0.006	2.0
Married at Contract	0.072	4.4	0.056	3.6	0.035	1.3
Body Mass Index	0.014	14.4	0.004	9.4	0.023	17.6
Enlistment Term Length (Omitted: 4-YO)						
Two Yr Contract	0.017	0.4	-0.026	-0.6	-0.039	-1.0
Three Yr Contract	-0.005	-0.3	0.016	1.2	0.013	0.8
Five Yr Contract	0.034	1.3	0.047	2.3	-0.035	-1.9
Six Yr Contract	0.029	1.0	-0.030	-1.3	-0.016	-0.8
Enlistment Incentives						
Bonus	0.046	2.3	0.062	3.4	0.018	0.9
Army College Fund	-0.020	-0.8	-0.033	-1.7	-0.051	-3.2
Bonus*3-YO	0.008	0.1	0.004	0.1	0.104	2.1
Bonus*5 or 6-YO	0.076	1.7	0.010	0.3	0.039	0.9
ACF*2-YO	-0.174	-3.2	-0.068	-1.4	-0.063	-1.5
ACF*3-YO	-0.119	-3.1	-0.093	-3.4	-0.123	-5.2
ACF*5 or 6-YO	-0.090	-0.8	0.044	0.6	0.104	1.5
State and Zipcode-Level Characteristics						
Percent College	-0.005	-3.6	-0.005	-4.3	-0.006	-4.8
Veteran Percent	-0.004	-2.2	-0.007	-4.6	-0.005	-3.6
Population Density	0.010	3.6	0.001	0.2	0.008	2.5
Family Income	0.022	3.5	0.016	3.2	0.021	4.1
Military Occupation Group (Omitted: Administrative)						
Combat Arms	0.146	6.5	0.120	6.5	0.062	3.5
Electronics	0.093	2.9	0.100	4.1	0.031	1.3

Communications	0.036	1.5	0.017	0.8	0.009	0.5
Medical	0.001	0.0	-0.018	-0.8	-0.019	-0.9
Other Technical	-0.027	-0.7	0.075	2.4	0.005	0.2
Elect Equip Repair	0.047	2.0	-0.003	-0.1	-0.038	-2.0
Craftsman	0.103	2.4	0.110	3.2	0.086	2.6
Supply & Service	0.137	5.8	0.095	4.9	0.070	3.6
Fiscal Year Group (Omitted: FY 1988-89)						
FY 1990-1993	0.168	10.4	0.276	18.1	0.265	19.1
FY 1994-1996	0.178	7.9	0.305	16.9	0.251	14.2
FY 1997-1998	0.190	7.9	0.319	14.4	0.208	9.8
Intercept	-0.728	-3.8	-0.764	-4.8	-1.692	-10.4
ρ	0.357		0.359		0.136	
σ^2_τ	0.554		0.559		0.157	
Sample Size	61871		95228		71847	
Log-likelihood	-60903.3		-87006.8		-59123.1	

Table A-2. Navy Panel Probit Estimates Through First Two Years of Service

	DEP Group 1		DEP Group 2		DEP Group 3	
Variable	**Coeff**	**z**	**Coeff**	**z**	**Coeff**	**z**
Economy Wide Pecuniary Factors (Time of Contract)						
Rel Mil Pay	-0.166	-1.5	-0.010	-0.1	0.036	0.5
Unemp Rate	-0.027	-4.9	-0.016	-3.2	-0.008	-2.3
Education (Omitted: Tier 1 HS Diploma Grad)						
Tier 1 in HS	0.093	2.7	-0.001	-0.1	-0.007	-0.6
Tier 1 Adult Ed	0.249	5.6	0.313	6.4	0.300	6.4
Tier 1 One Sem Coll	0.246	5.6	0.308	6.3	0.192	3.8
Tier 1 Assoc Deg	-0.251	-3.3	-0.211	-2.7	-0.212	-2.9
Tier 1 College Deg	-0.211	-3.5	-0.143	-2.5	-0.140	-2.5
Tier 2 GED	0.459	16.7	0.485	15.1	0.446	10.6
Tier 2 Near Complete	0.279	3.9	0.383	8.6	0.375	11.1
Tier 2 HS Attend Cert	0.362	2.5	0.351	2.3	0.288	1.7
Tier 3 Non-HSG	0.458	14.7	0.511	13.9	0.277	6.1
Personal Characteristics						
AFQT Score	-0.004	-9.8	-0.002	-5.3	-0.003	-9.4
Male	-0.044	-2.4	-0.062	-3.4	-0.107	-8.3
Black	-0.225	-12.8	-0.189	-10.8	-0.111	-8.7
Hispanic	-0.147	-5.8	-0.154	-6.3	-0.119	-7.0
Other	-0.300	-10.2	-0.282	-9.9	-0.185	-9.1
Contract Age	0.022	8.9	0.010	3.8	0.019	6.9
Married at Contract	0.048	1.8	0.036	1.2	0.049	1.5
Body Mass Index	-0.001	-0.4	0.002	0.9	0.001	1.0
Enlistment Term Length (Omitted: 4-YO)						
Three Yr Contract	0.020	1.0	0.002	0.1	-0.026	-1.4
Five Yr Contract	-0.096	-3.3	-0.119	-4.5	-0.131	-7.8
Six Yr Contract	-0.184	-7.0	-0.177	-7.1	-0.128	-7.6
Enlistment Incentives						
Bonus	-0.110	-3.8	-0.120	-4.3	-0.033	-1.7
NCF	-0.148	-5.2	-0.287	-10.9	-0.112	-6.3
State and Zipcode-Level Characteristics						
Percent College	-0.008	-4.7	-0.007	-4.3	-0.007	-6.5
Veteran Percent	-0.008	-4.1	-0.006	-3.3	-0.005	-3.4
Population Density	0.006	1.9	0.006	1.7	0.005	1.7
Family Income	0.031	4.3	0.011	1.6	0.010	2.0
Military Occupation Group (Omitted: Administrative)						
Combat Arms	-0.240	-6.9	-0.155	-5.1	-0.100	-4.6
Electronics	-0.154	-4.2	-0.093	-3.0	-0.116	-5.5
Communcations	-0.196	-4.9	-0.228	-6.6	-0.161	-7.1
Medical	-0.414	-8.8	-0.358	-8.9	-0.239	-9.7
Other Technical	-0.179	-1.5	-0.306	-3.6	-0.173	-3.2
Elect Equip Repair	-0.083	-2.2	-0.007	-0.2	-0.072	-3.6
Craftsman	-0.186	-3.7	-0.138	-3.3	-0.079	-2.9
Supply & Service	0.041	0.9	0.071	1.7	0.019	0.7

Not Elsewhere Class	-0.473	-2.9	-0.020	-0.2	0.048	0.7
Unknown	-0.048	-1.3	-0.016	-0.5	-0.051	-2.2
Fiscal Year Group (Omitted: FY 1988-89)						
FY 1990-1993	0.187	9.9	0.195	10.6	0.251	18.7
FY 1994-1996	0.340	14.3	0.339	14.2	0.334	18.5
FY 1997-1998	0.261	9.0	0.298	9.6	0.191	8.5
Intercept	-0.511	-2.2	-0.901	-4.0	-1.156	-7.2
ρ	0.500		0.442		0.261	
σ^2_τ	1.001		0.792		0.353	
Sample Size	57814		56748		86880	
Log-Likelihood	-62448.1		-54924.1		-75284.6	

Figure 1. Conditional Taste Distributions

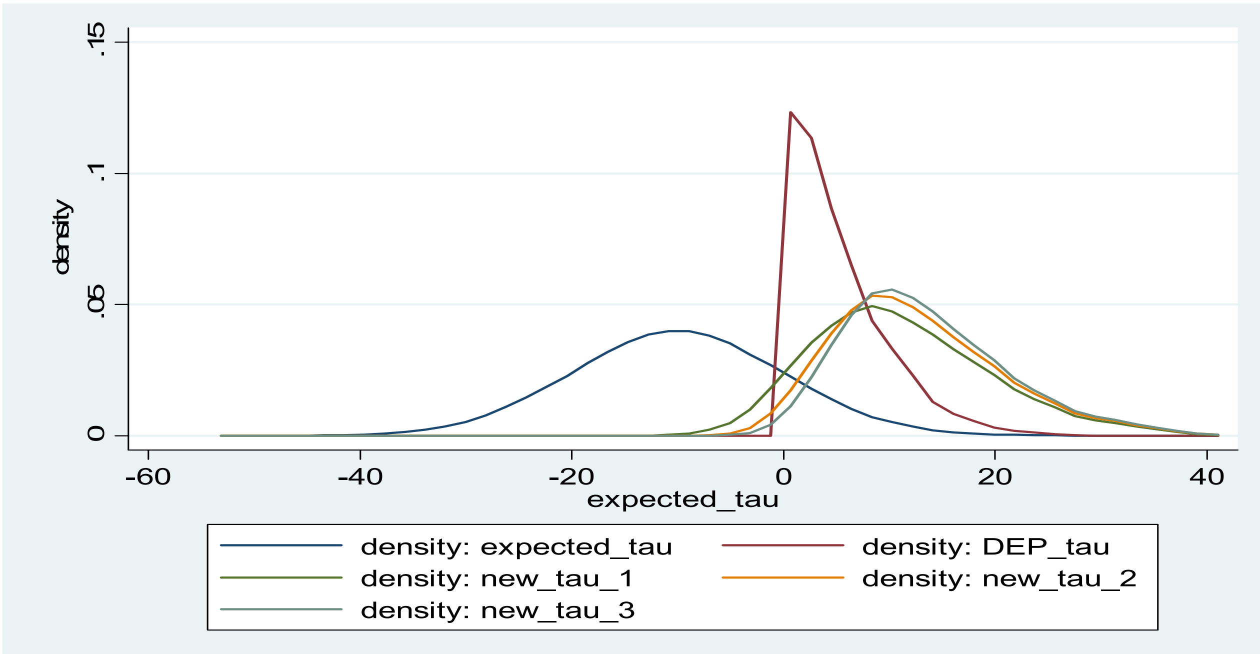

Figure 2: Predicted Army Attrition by Period

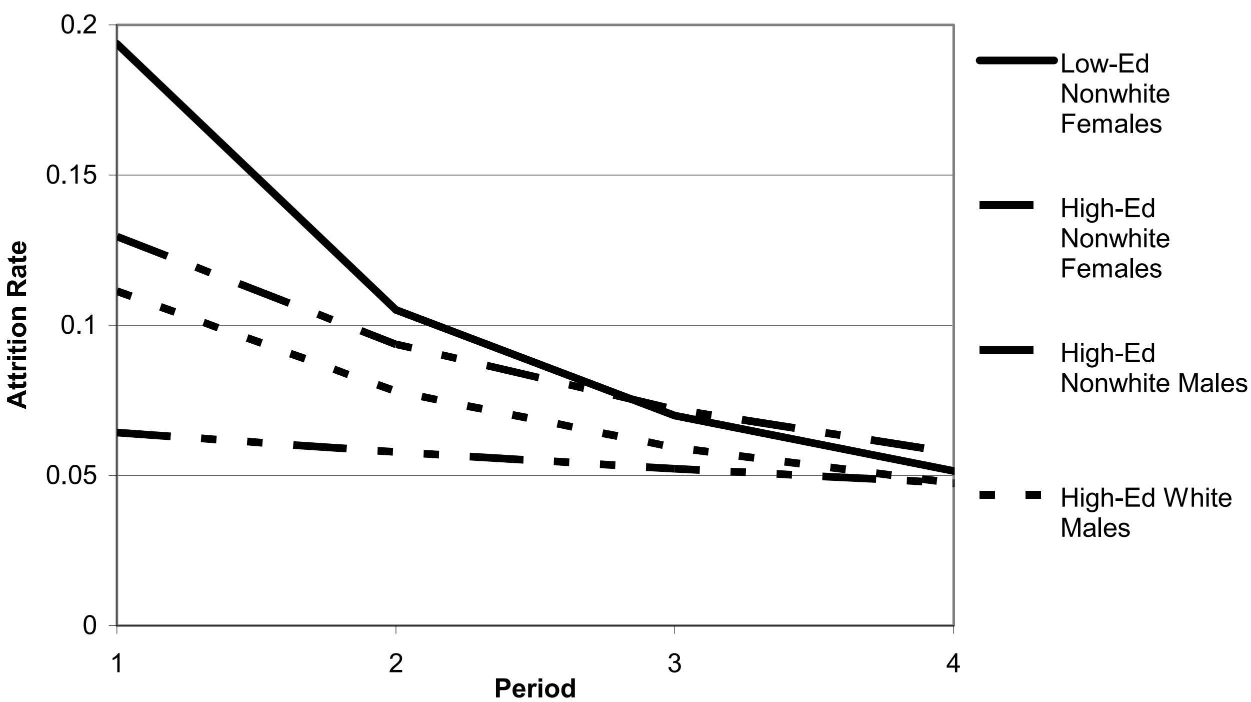

Figure 3: Predicted Army Attrition Differences Between DEP Groups 1 & 3
(Hi Ed = 1, Male = 1, White = 1)

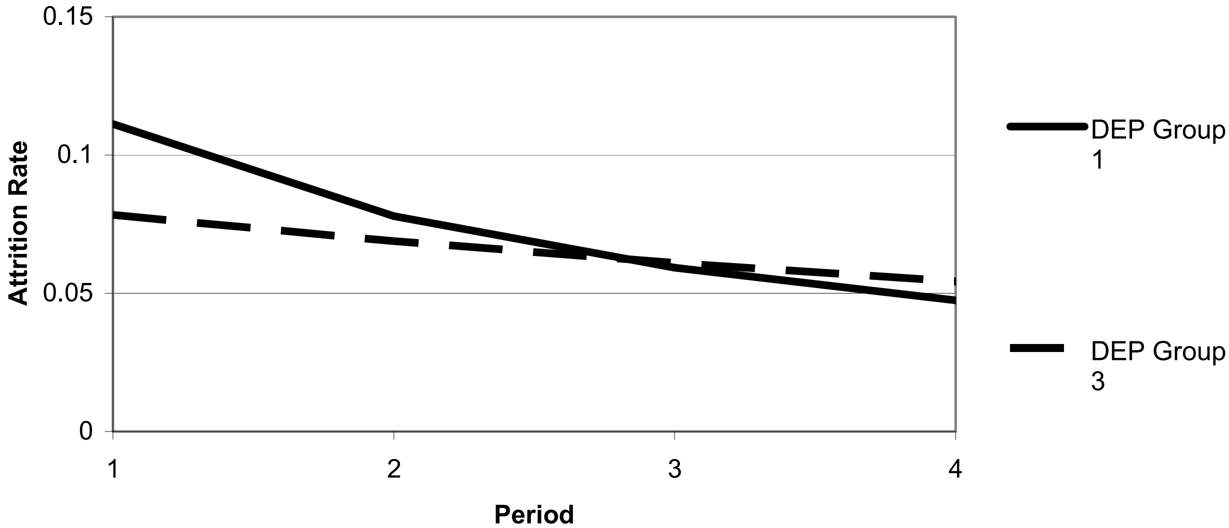

Figure 4: Predicted Navy Attrition by Period