Technical Report 708

The Impact of Soldier Quality on Performance in the Army

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The Army has been successful in improving its manpower quality over the last several years. Recruits are scoring higher on the Armed Forces Qualification Test (AFQT) and are more likely to have high school diplomas than in any year since the inception of the All-Volunteer Force. Recruiting such personnel is expensive, however, as the Army faces increased competition from the civilian labor market, educational institutions, and the other services for a shrinking youth population. In order to justify its manpower quality requirements, the Army must be able to demonstrate an --> (Continued)

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empirical link between AFQT scores and soldier performance. This study presents evidence on that relationship using data from several sources. The first data set contains written and hands-on tests on several weapons systems from the Army's training schools. The second data set utilizes the Skill Qualification Tests administered by the Army. The results demonstrate that a statistically significant and positive relationship exists between AFQT scores and performance measures. These findings are consistent across a wide range of Military Occupational Specialties.

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The Impact of Soldier Quality on Performance in the Army

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FOREWORD

The Manpower and Personnel Policy Research Group of the Army Research Institute (ARI) performs research in the issues of manpower, personnel, and training of particular significance to the U.S. Army. This research addresses the issue of the effectiveness of Armed Forces Qualification Test in predicting manpower performance and was prepared as part of ARI's continuing support for the Office of the Deputy Chief of Staff for Personnel.

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THE IMPACT OF SOLDIER QUALITY ON PERFORMANCE IN THE ARMY

EXECUTIVE SUMMARY

Requirement:

The Army has been successful in improving its manpower quality over the last several years. Recruits are scoring higher on the Armed Forces Qualification Test (AFQT) and are more likely to have high school diplomas than in any year since the inception of the All-Volunteer Force. Recruiting such personnel is expensive, however, as the Army faces increased competition from the civilian labor market, educational institutions, and the other services for a shrinking youth population. In order to justify its manpower requirements, the Army must be able to demonstrate an empirical link between AFQT scores and soldier performance: AFQT is designed to measure trainability. However, its value as a predictor of performance must be empirically verified. This research presents evidence on that relationship using data from several sources: the Army's training schools and Skill Qualification Tests (SQT).

Procedure:

The performance measures are modeled in a multivariate regression model, using an instrumental variables technique to correct for measurement error in the AFQT variable. Other explanatory variables are sex, race, education, Army experience, and training.

Findings:

The results of the analysis on the TRASANA training data and the 1983 skill level two SQT data demonstrate that AFQT, a measure of trainability, is a significant predictor of performance in the Army. The performance and skill measures used in this study are imperfect, but the consistency of the relationship across types of performance measures and across MOS is impressive. The analysis of the SQT data is reported for several large representative MOS, but the pattern is also consistent for almost all MOS having sufficient observations to permit analysis. Holding the effect of other variables constant, AFQT exerts a positive and significant influence on Army performance. No other variables are consistently significant across all MOS in both data sets. These findings are consistent with another study that also documented the positive impact of AFQT scores on Army soldier performance for tankers.

Utilization of Findings:

The empirical analysis demonstrates that AFQT scores are indeed a significant and consistent determinant of Army performance for a variety of performance measures. The equations indicate how much additional performance, on average, is associated with an increase in AFQT scores. This information

supports the current Army policy of recruiting high-quality manpower, because the higher recruiting costs are offset by increased labor productivity. Earlier versions of this analysis done in collaboration with MAJ Thomas Daula were used by the Army to support current quality-recruiting goals before Congress in Defense Manpower Quality, Report to the House and Senate Committees on Armed Services, Volume 11, May 1985, appendixes E and I.

THE IMPACT OF SOLDIER QUALITY ON PERFORMANCE IN THE ARMY

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The Impact of Soldier Quality on Performance in the Army

David K. Horne*

The productivity of an individual on the job depends upon such unobservable personal attributes as ability, motivation, physical coordination, and other job-specific skills. Employers who lack information on the potential productivity of job applicants may use various proxies for these skills. Education, for example, may be an indicator of productivity if individuals learn skills in school which may be applied to the job. This is the assumption of the human capital model.[1] Alternatively, if individuals with more 'ability' are more likely to have additional education through a sorting mechanism, education and productivity will be positively correlated. Employers may then use education to screen applicants.[2] Education, experience, scholastic achievement and other productivity proxies may be useful for predicting performance on the job.

One alternative to using general performance or skill proxies is to develop instruments which could be expected to predict performance. For example, college entrance exams are used to predict scholastic success. Another example is the test which the Armed Forces administer each year to hundreds of thousands of youths. The Armed Forces Qualifications Test (AFQT) is designed to measure the trainability of applicants. The test is used by all the services to screen out individuals who might be expected to fail training in their MOS. (Army jobs are classified into Military Occupational Specialties (MOS)).

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This screening device can be defended only if a relationship exists between the test score and job or MOS performance, since the objective of the selection process is to acquire recruits who will perform well as soldiers rather than as students. This analysis demonstrates that AFQT score is positively related to MOS-specific performance. This conclusion has specfic policy implications. Current Army recruiting policy requires substantial resources to attract high-scoring recruits, turning away many individuals who desire to enlist but who do poorly on the AFQT. The emphasis on the so-called high quality recruits can only be justified if AFQT scores can be shown to be a determinant of productivity.

Section 1 discusses the methods and uses of the AFQT and peformance tests in the Army. Section 2 contains a discussion of the model and the data used in the analysis. The results are discussed in section 3. Policy implications and conclusions are presented in section 4.

Ability and Performance

The purpose of this analysis is to relate the Army's measure of trainability to job or MOS performance measures. The trainability measure will be discussed first, followed by a discussion of performance measures.

Ability Measurement

One can argue that 'ability' is too broad and ambiguous to be measured well on a one-dimensional scale. Nor is ability the Army's primary concern. The Army takes recruits, many with no prior work experience, and trains them in a particular MOS. Advanced individual training is accomplished subsequent to basic training and may last from as little as six weeks to as long as six months or more. The concept of trainability is well defined. The AFQT is designed to be a general measure of trainability and is composed of a number of sub-tests of the Armed Services Vocational Aptitude Battery.

Other combinations of subtests, known collectively as aptitude area composites, are created to measure more narrow types of aptitude for mechanical, electronics, clerical and other areas.

Individuals tested are assigned scores in percentile terms relative to the 1980 youth population of 18-23 year olds. By law the applicants must score above the 9th percentile to be eligible for enlistment. The number of applicants who can be recruited in the 10th through 30th percentiles, particularly without a high school diploma, is also limited by Congressional mandate. However, the Army attempts to recruit above-average (AFQT of 50 or above) individuals whenever possible. The percentage of non-prior service regular Army recruits scoring in the top 50 percentiles has risen from 26.0 percent in fiscal year 1980 to 63.4 percent in fiscal year 1984. Over the same period the number of male recruits with high school diplomas has risen from 48.9 percent to 89.4 percent. This trend can be attributed partially to changes in recruiting practices as well as to changes in the recruiting market.

Recruiting high quality individuals, defined both in terms of AFQT scores and high school diploma status, is particularly expensive. Substantial recruiting resources are devoted to attracting these individuals to the Army, because the Army faces considerable competition from educational institutions, the civilian labor market, and other services. At the same time, the Army turns away many lower quality applicants who could be obtained at a much lower recruiting cost.

There are two easily identified benefits to recruiting high quality individuals. These recruits tend to complete their tours more often than lower category recruits. It is costly for the Army to recruit and train soldiers who leave the Army before completing the tour.[3] Attrition rates have reached 30 percent in recent years. The second benefit is performance. As equipment used in the Army becomes increasingly sophisticated, increased productivity in Army manpower will translate into cost savings and increased force readiness. Unfortunately, neither productivity nor performance can be easily measured.

Performance Measures

Manpower productivity in the Army is not easily defined. Soldiers trained for combat might be considered most successful if they are a deterrent to war. Skills which may be valuable during peace may be less valuable during combat, while combat skills may produced little 'output' during peacetime. However, other things constant, the Army should prefer soldiers who can operate or maintain equipment to those who cannot, or soldiers who can successfully distinguish between friendly and hostile aircraft and who can hit targets to those who cannot. Although the value of 'output' is difficult to ascertain, the Army does evaluate soldier proficiency. These proficiency tests may be considered one type of performance measure.

This study uses two performance measures. The first source is composed of test scores on a variety of written and hands-on tests from the Army's training schools. The tests will be discussed in more detail in the next section. The AFQT was originally validated on training data and should be positively associated with the training test scores.

The second performance measure used in this study is the Skill Qualifications Test (SQT). The SQT is currently a written (multiple choice) test created by subject matter experts for each MOS (except for a number of exempt MOS). A SQT is given each year at four different skill levels which correspond to experience. The skill level ˆ test is administered to soldiers through the E-4 grade. The skill levels 2 through 4 are given to grades E-5, E-6, and E-7 respectively. Soldiers are tested on MOS-specific tasks which are contained in the Soldier's Manual for each MOS.

The SQTs are not direct performance measures. Rather, they measure skills and knowledge required for performing the tasks. It is reasonable to assume that soldiers who score higher on the SQT, other things equal, will demonstrate better performance in the field.

However, the SQTs suffer from a number of deficiencies. A U.S. General Accounting Office report noted that the SQT is used by the Army for two somewhat inconsistent functions[4]. The SQTs were originally developed to evaluate training programs and to indicate deficiencies in training. The tests are also used for personnel evaluations. The test score is recorded on soldier's personnel files and is used for promotion decisions. A score of 80 is required for promotion unless a waiver is obtained. Because commanders are responsible for preparing their troops to do well on the SQT for their personnel evaluations, training becomes directed toward improving evaluations rather than improving skills, and both functions of the SQTs become less effective.

Before the SQTs are administered each year, soldiers are given a list of the critical tasks on which they will be tested. Those soldiers who receive refresher training may train specifically for those tasks, and training often occurs just prior to the SQT testing. Therefore the annual refresher training designed to maintain skills is largely directed towards passing the current SQT. In addition, analysis of Army personnel files indicates many missing values for SQT scores. About 30 percent of the enlisted personnel files for E-5 had no SQT score by the end of 1984.

In spite of problems with the SQT, the test does provide a measure of skill knowledge for a wide range of MOS. The direct link between SQTs and actual job or MOS proficiency is not observed. However, given the nature of the tests, it seems reasonable to assume that soldiers who demonstrate greater skill knowledge on the SQTs will generally be more productive in the MOS. Numerous other personal attributes, some observable and some unobservable, will also influence productivity. We attempt to control for some of the observable characteristics in the regression equations.

The Model

There are a number of variables which are associated with productivity in the human capital and signalling models. Experience for example, should increase job skills because training takes place over time. Education may provide marketable skills and may also act as a sorting mechanism. In this sample of enlisted soldiers there is little variance in years of education, but variation in high school diploma status does exist. Graduates are probably more motivated and goal oriented.

The type of training received by soldiers is also an important determinant of productivity. Information is not available on the quality of training, but it is possible to distinguish between soldiers who have been assigned to MOS in which they received their training and those who have been assigned to MOS for which they were not trained.

Several demographic variables included in this analysis are likely to influence SQT scores. Opportunities for education, training or employment in the civilian sector may differ by race or sex. The propensity or taste for military service may also differ between these groups. The other variables included in the model cannot fully correct for these unobserved differences between groups. Therefore both sex and race may be significant variables in the equations.

The general model is specified in the following form:

1. Performance=f(Trainability, Education, Experience, Training, Sex, Race).

The variables used as measures of these are:

Performance:	Training Data, SQT scores
Trainability:	AFQT scores
Education:	High School diploma status
Experience:	Months in service, rank
Training:	Training in same MOS
Sex:	Sex
Race:	White or non-white

The major relationships of interest in this research is between trainability and performance. AFQT is an accepted measure of trainability. More trainable persons are more likely to acquire the skills and knowledge required to perform their military assignments. AFQT may also reflect abilities other than those required for training success which contribute directly to performance. This analysis does not distinguish between the two processes.

Other variables, such as education and experience, may also contribute to job performance. These variables may have a direct effect on performance because they are correlated with skills or knowledge or ability. Such variables may also have an indirect through the AFQT variable: more education is associated with higher AFQT scores, for example. The purpose of using multivariate regression estimation is to measure the direct contribution of each variable. Excluding variables such as education or experience which may be significant determinants of performance leads to omitted variable bias - the estimates of the impact of AFQT will be biased. This estimation problem has policy repercussions. If AFQT is positively correlated with experience and education, for example, a univariate regression of SQT score against AFQT score will exaggerate the effect of the AFQT variable. The considerable cost of administering the AFQT and of recruiting high-scoring individuals can only be defended if AFQT has an effect on performance independent of other variables. If AFQT is a proxy for education, for example, then education and not AFQT score should be the selection criterion. Therefore, neither simple correlations or univariate regression results can be used to defend manpower quality goals specified in terms of AFQT scores. AFQT score is only appropriate as a selection criteria if the it contibutes to soldier performance independent of other variables.

Estimation of the relationship between performance and the explanatory variables is complicated by the fact that AFQT score is an imperfect measure of ability or trainability. Therefore the observed data matrix, **X**, consists of the true data $\tilde{X}$ plus a measurement error term V;

$$2.\quad X = \tilde{X} + V.$$

The true model may then be expressed as

$$3.\quad y = \tilde{X}\beta + u = X\beta + (u - V\beta),$$

where y and u denote the independent variable and error matrices respectively. The least-squares estimator of the true coefficient is

$$4.\quad \hat{\beta} = (X'X)^{-1} X'y.$$

Johnson has demonstrated that the ordinary least squares estimator of β given in equation 4 is inconsistent and asymptotically biased because the observed data matrix is correlated with the error term[5]. One method to correct for the errors-in-variables is the instrumental variables (IV) technique. An instrumental variables estimator will be consistent and asymptotically unhaised. If the matrix Z is an instrument which is uncorrelated with the errors such that plim $({}^1/n\ Z'u) = 0$, the IV estimator of β is b, where

$$5.\quad b = (Z'X)^{-1} Z'y$$

and the asymptotic variance of b is

$$6.\quad \text{asy var}(b) = \sigma_u^2 (Z'X)^{-1} Z'Z (X'Z)^{-1},$$

where τ denotes the variance of the error term (u).

The instrument chosen for AFQT score in this study is the rank ordering of scores, where the lowest score receives a value of one and the highest score receives a value of n. This is shown as a Durbin instrument[6]. This instrument is correlated with AFQT score, but is uncorrelated with the errors. The other explanatory variables are used as their own instruments.

Data

This analysis uses two data sets. The first data set is training data for selected MOS. The second data set includes SQT scores from the 1983 test.

Training Data

The training data (from the Army Training Centers) included a number of MOS from several missile systems. The PERSHING II missile data covered basic maintanence testing for MOS 15E and 21G (MOS descriptions are provided in the appendix) and was created from multiple-choice questions. The STINGER antiaircraft system (MOS 16S) testing included a written test on system knowledge, preventive maintanence, system characteristics and other operations; a range ring profile test of aircraft type, range ring coverage, and correct action; two visual aircraft recognition tests (photo test and test from slides) and two hands-on tests. The first hands-on test was probability of completing launch sequence in a moving target simulator, the second was time-to-fire. The LANCE testing consisted of several tests for MOS 15D and 15J. The written test questions were taken from LANCE manuals and SQTs. A map reading test consisted of 17 multiple choice questions. Each LANCE MOS was also given hands-on operations and maintanence tests. The HAWK missile system MOS were given written and hands-on tests for general equipment knowledge (16D & 16E) and equipment maintanence (24C, 24E, 24C).

These hand-on tests are MOS-specific. Soldiers responsible for maintenance, for example, are asked to perform system checks, or to diagnose and repair faults which have been inserted in the equipment. Operators are asked to identify aircraft from pictures or slides, make the correct firing decision, and complete the launch sequence. The tests are carried out at the training centers and are designed to reflect the tasks which the soldiers will perform. The tests are created with the assistance of system experts.

The training data set contains a number of variables which may be used as explanatory variables in the regession. These include sex, race, education, and training information for each soldier. Limited information on length of service, which is an experience proxy, is available for some of the MOS. Much of the time-in-service data is missing, but rank data are available. Rank is largely a function of time in service, though more productive soldiers should be expected to be promoted more rapidly[7]. Therefore rank should, and in fact does appear to, have more explanatory power than time in service alone. Rank cannot be strictly interpreted as an experience variable, but is used as a proxy for experience. This variable is used in the training regressions.

The education variable has little variation. Few members of the sample have attended college. Past research has shown that the education variable which appears to have the most impact on soldier behavior is high school diploma status. This is not only an indicator for the amount of education, but may also reflect an individual's tenacity and determination to reach goals. The training variable (SAMEMOS) indicates whether an individual received training in the same MOS covered by the SQT test. Generally, one would expect that training in the same MOS, high school diploma and rank should all exert a positive influence on SQT score.

The trainability variable used in this study is AFQT score. The applicants are required to take the AFQT to enter the Army, so scores should be available for each soldier. Soldiers who took the AFQT originally between 1976 and 1980 received scores that were misnormed, but they have been renormed for this analysis. MOS performance can be considered the joint output of trainability of the individual and the training program. Given a fixed training program, the AFQT score is expected to have a positive impact on MOS performance.

Some assumptions behind the analysis should be made explict. In particular, the training program is held constant. It is likely that changes in the training program will affect the impact of AFQT on performance. The more effective the training program, the more proficient the soldiers should become. Trainability could become less important as training effectiveness improves, though some tradeoff between trainability and performance would be anticipated with any training program. The estimated impact of AFQT on these performance measures is conditional on the training received by the soldiers. Consistent AFQT effects across MOS would indicate that the trainability is important under a range of training programs.

SQT Data

The SQT analysis utilized the skill level 2 SQTs (rank E-5). Many of those who had taken skill level 1 SQTs had taken different versions of the AFQT which are not strictly comparable, though preliminary analysis showed that these SQT results were similar. The SQT level 3 and 4 samples were relatively small. A sample of almost 53,000 observations was available for skill level 2 tests.

SQT scores are recorded in the Army's enlisted personnel files, called the Enlisted Master File (EMF). Other available variables that could be expected to influence performance include AFQT scores, education, training, race, and time-in-service. The variables used in the regression analysis are similar to those used in the training data analysis. The results for several large, representative MOS are presented in this paper; these are generally consistent with the results for other MOS not reported here. The

MOS descriptions are provided in the appendix.

Results

Training Results

The Training equations are provided in Tables 1 through 3 for several weapons systems: the HAWK, STINGER, PERSHING II, and LANCE. The equations for the two types of tests, written and hands-on, are provided separately.

The results of the written tests (shown in Table 1) demonstrate that the AFQT variable is consistently significant across systems and MOS. The lack of a high school diploma is significantly negative in only one equation. Rank is always positive and generally significant. The race coefficient varies, being significantly positive in one equation and negative in two. The training in the MOS has mixed effect.

The two variables which stand out consistently are AFQT score and rank. In the written tests, AFQT score is positive and significant in 10 of 11 equations, while rank is positive and significant in 9 of the equations. No other variables are as consistent across equations, either in sign or significance. Trainability and experience appear to be the major determinants of the written test scores in these equations.

The hands-on tests which are reported in Tables 2 and 3 are less conclusive. AFQT is significantly positive in 6 of the 11 equations. The pattern is similar for rank. The negative coefficient for the time-to-fire test is consistent with the other results, since brighter and more experienced soldiers should be able to fire the mechanism in less time. The effect of the other variables tends to vary across MOS.

Table 1

TRAINING DATA: WRITTEN TESTS

Instrumental Variable Regression Equations

System	MOS	Intercept	AFQT	NHSG	RANK	RACE	SAMEMOS	N
PERSHING II	15E	4.62*	0.20*	0.27	5.56*	-8.99*	-2.58	167
		(1.72)	(0.03)	(1.79)	(0.78)	(2.03)	(1.97)	
PERSHING II	21G	0.79	0.15*	-0.55	8.60*	-2.96	2.35	167
		(1.43)	(0.03)	(1.50)	(0.65)	(1.69)	(1.65)	
STINGER	16S	-1.94*	0.17*	2.36	2.17*	3.30*	- [d]	279
		(0.59)	(0.02)	(1.23)	(0.43)	(1.20)	-	
STINGER	16S[a]	9.69	0.78*	-17.79	3.67	-9.42	- [d]	309
		(6.34)	(0.15)	(11.50)	(4.44)	(11.92)	-	
STINGER	16S[b]	1.67	0.04	-7.66*	6.05*	1.94	- [d]	309
		(1.15)	(0.03)	(2.09)	0.80	(2.16)	-	
LANCE	15D	0.24	0.23*	-0.43	7.23*	-1.97	0.89	150
		(1.90)	(0.03)	(1.95)	(0.90)	(2.33)	(1.89)	
LANCE	15D[c]	1.70	0.29*	-.22	5.11*	-9.24*	1.61	151
		(2.44)	(0.04)	(2.51)	(1.15)	(3.00)	(2.43	
HAWK	16D	2.24	0.02*	-1.93	0.26	-2.75*	1.45	512
		(1.32)	(0.01)	(1.07)	(0.52)	(1.22)	(1.24)	
HAWK	16E	1.25	0.19*	0.39	3.33*	-2.20	-1.89	355
		(1.40)	(0.01)	(1.07)	(0.52)	(1.17)	(1.38)	
HAWK	24C	-0.44	0.21*	1.10	2.49*	0.55	-0.54	116
		(4.00)	(0.04)	(2.33)	(1.21)	(2.37)	(2.81)	
HAWK	24G	0.44	0.17*	-2.12	2.27*	-.47	1.07	124
		(2.53)	(0.36)	(2.28)	(0.95)	(1.99)	(2.73)	

a. Range Ring (aircraft) Profile Test
b. Visual Aircraft Recog. Test
c. Map reading
d. New MOS

Standard errors in parenthesis
*Significant at .05 level

Table 2

TRAINING DATA: HANDS-ON TESTS

INSTRUMENTAL VARIABLE REGRESSION EQUATIONS

System	MOS	Intercept	AFQT	NHSG	RANK	RACE	SAMEMOS	N
STINGER	16S[a]	-1.25 (1.98)	-0.04 (0.06)	2.98 4.02	3.85* (1.38)	1.22 3.98	-	225
STINGER	16S[b]	-10.09* (4.43)	-0.09 (0.17)	14.19 (8.61)	-5.73 (3.05)	15.13 (8.31)	-	104
HAWK	16D[c]	4.69 (2.95)	0.37* (0.03)	-4.21 (2.43)	6.59* (1.20)	-4.97 (2.73)	1.01 (2.82)	446
HAWK	16E[c]	1.68 (3.67)	0.33* (0.03)	-0.98 (2.82)	4.07* (1.35)	-2.73 (3.07)	-0.69 (3.61)	325
HAWK	24C[d]	1.52 (3.14)	0.07 (0.05)	-0.38 (3.05)	1.83 (1.23)	-4.52 (2.59)	2.03 (3.56)	116
HAWK	24G[d]	-0.69 (6.14)	0.14 (0.07)	-6.82 (3.66)	5.09 (1.88)	5.26 (3.70)	2.45 (4.38)	114

a. Probability of successfully completing launch sequence - moving target simulator
b. Time-to-fire (expect opposite signs for this equation)
Standard errors in parenthsis
*Significant at .05 level

Table 3

TRAINING DATA: LANCE HANDS-ON TESTS

INSTRUMENTAL VARIABLE REGRESSION EQUATIONS

Test	MOS	Intercept	AFQT	NHSG	Rank	Race	SMOEMOS	N
1.	15D	9.90	-0.08	-3.22	6.94	-13.50	-10.96	127
		(8.15)	(0.14)	(8.08)	(5.89)	(9.75)	(8.81)	
2.	15D	-0.31	0.17*	0.77	4.48	4.05	-2.67	127
		(4.33)	(0.08)	(4.29)	(3.13)	(5.18)	(4.68)	
3.	15D	4.40	0.37*	-5.85	6.80	10.22	-9.70	127
		(5.40)	10.09	(4.99)	(3.64)	(6.02)	(5.45)	
4.	15D	3.48	0.21*	-3.06	7.85*	-9.70*	0.13	127
		3.98	(0.07)	(3.94)	(2.88)	(4.76)	(4.30)	
5.	15D	2.15	0.19*	0.17	0.22	-0.49	-4.44	127
		(2.80)	(0.05)	(2.78)	(2.01)	(3.35)	(3.03)	

Test: 1. Boresight missile round
2. Cold fluid level check
3. Inspection of warhead section
4. Inspection of missile round items
5. Missile round checkout

Standard errors in parenthesis
* Significant at .05 level

SQT Results

The SQT results are demonstrated for several MOS which are generally representative of MOS within the Army, and which are of sufficient size to provide more precise parameter estimates. The results, shown in Table 4, are in many ways similar to the training results. The AFQT variable is significant and positive in all the MOS, with the coefficient ranging from .07 to .26. The coefficient of .26 implies that for each 4 additional points on the AFQT scored by a soldier, one would expect the SQT score to increase by about 1 point on average.

The high school diploma variable is less important than the AFQT variable as a predictor of SQT scores. The lack of a diploma is insignificant in all of the six equations. The signs of the other variables are generally consistent across equations. The experience variable, time-in-service, has a positive effect, as does training in the same MOS (SAMEMOS). The effect of sex generally varies across MOS. The race variable is significant in four of the six equations; the non-white group has a negative impact.

Conclusions

The results of the analysis on the TRASANA training data and the 1983 skill level 2 SQT data demonstrate that AFQT, a measure of trainability, is a significant predictor of performance in the Army. The performance and skill measures used in this study are imperfect, but the consistency of the relationship across types of performance measures and across MOS is impressive. The analysis of the SQT skill level 2 data is reported for several large representative MOS, but the pattern is also consistent for almost all MOS having sufficient observations to permit analysis. Trainability, as measured by AFQT,

Table 4

SQT Instrumental Variable Regression Equations

Selected MOS

MOS	Intercept	AFQT	NHSG	SERTIME	SEX	RACE	SAMEMOS	N
05C	60.33* (2.59)	0.14* (.005)	-0.65 (.85)	0.12* (.03)	-	-1.54* (.75)	1.00 (.91)	935
11B	64.13* (0.78)	0.18* (.00)	-0.48 (.28)	-.02 (.01)	-	-4.57* (.28)	2.27* (.37)	3737
63B	77.51* (1.28)	0.07* (.00)	0.68 (.41)	0.05* (.02)	-	-2.16 (.41)	1.21* (.42)	1855
75B	47.49* (2.04)	0.26* (.01)	-0.10 (.97)	0.07* (0.02)	0.15 (.99)	-2.96* (.86)	7.11* (.85)	970
94B	62.41* (1.48)	0.14* (.00)	-0.04 (.66)	-0.06* (.02)	-2.16* (.78)	-3.84* (.62)	2.98* (.68)	1410
98C	52.50* (4.62)	0.15* (.02)	0.25 (4.85)	0.20* (.06)	-2.17 (1.28)	-1.51 (2.44)	6.26* (1.94)	255

Standard errors in parenthesis
*Significant at .05 level

exerts a positive and significant influence on Army SOT performance, holding the effect of other variables constant. No other variables appear to be consistently significant across all MOS in both data sets. These findings are consistent with another study which also documented the positive impact of AFQT score on Army soldier performance for tankers [8]. These results support the use of AFQT as a screening device for Army applicants.

The analysis implicitly assumes that training policies remain stable and that increased manpower performance can be attained by attracting higher quality recruits. The returns due to changes in quantity or quality of training cannot be estimated in this framework. If training policies were significantly altered, the relationship between AFQT and performance might be expected to change, although the direction of the change cannot be predicted _a priori._ The performance measures themselves are also likely to change over time. Yet evidence of a positive relationship between performance and skill measures on the one hand, and the AFQT on the other, is fairly convincing. The impact of other variables on performance is less consistent. The high school diploma generally does exert a positive impact on performance, as does experience and MOS-specific training.

REFERENCES

Baldwin, Robert H. and Thomas V. Daula. "The Cost of High-Quality Recruits." Armer Forces and Society 2, No. 1 (Fall 1984): 96-114.

Becker, Gary S. Human Capital. Second Edition. New York: Columbia University Press (for Nat. Bur. Econ. Res.), 1975.

Johnson, J. Econometric Methods, 2nd Edition. New York: McGraw Hill, 1972.

Mincer, Jacob A. Schooling, Experience and Earnings. New York: Columbia University Press (for Nat. Bur. Econ. Res.), 1974.

Nord, Roy and Thomas Daula, Estimated Time to Promotion for Enlisted Soldiers, paper presented at The Information Management/Operations Research Society of America Conference, Boston, MA; July 1985.

Riley, John G. "Testing the Educational Screening Hypothesis." J.P.E. 87, No. 5, 2(October 1979): S227-S252.

Scribner, Barry L., D. Alton Smith, Robert H. Baldwin and Robert W. Phillips. Are Smart Tankers Better Tankers: AFQT and Military Productivity. Office of Economic and Manpower Analysis, Department of Social Sciences, U.S. Military Academy, December 1984.

Stiglitz, Joseph E. "The Theory of Screening, Education, and the Distribution of Income." American Economic Review 65 (June 1975): 283-300.

U.S. General Accounting Office, Report to the Secretary of the Army. The Army Needs to Modify its System for Measuring Individual Soldier Status. Report to the Secretary of the Army. March 30, 1982.

Weiss, Andrew. "A Sorting-cum-Learning Model of Education." Journal of Political Economy 91,No. 3, (June 1983): 420-442.

Appendix

MOS Descriptions

MOS	Description
05C	Radio Operator
11B	Infantryman
15D	Lance Crewmember
15E	Pershing Missile Crewmember
16D	Hawk Missile Crewman
16E	Hawk Fire Control Crewmember
16S	Stinger Crewman
21G	Pershing Electric Maintenance Specialist
24C	Hawk Firing Section Mechanic
24G	Hawk Coordination Central Mechanic
63B	Light Vehicle/Power Generation Mechanic
75B	Personnel Administration Specialist
94B	Food Service Specialist
98G	Electronic Warfare/Signal Intelligence V

NOTES

1. Expositions of the human capital model include Gary S. Becker, Human Capital. Second Edition. New York: Columbia University Press (for Nat. Bur. Econ. Res.), 1975, and Jacob A. Mincer, Schooling Experience and Earnings. New York: Columbia University Press (for Nat. Bur. Econ. Res.), 1974.

2. See, for example, Joseph E. Stiglitz. 'The Theory of Screening, Education, and the Distribution of Income.' American Economic Review 65 (June 1975): 283-300, John C. Riley, 'Testing the Educational Screening Hypothesis.' Journal of Political Economy 87, No. 5, 2(October 1979): S227-S252, and Andrew Weiss, 'A Sorting-cum-Learning Model of Education.' Journal of Political Economy 91, No. 3, (June 1983): 420-442.

3. This argument is made by Robert H. Baldwin and Thomas V. Daula, 'The Cost of High-Quality Recruits,' Armed Forces and Society II, No. 1 (Fall 1984): 96-114.

4. See U.S. General Accounting Office, Report to the Secretary of the Army. The Army Needs to Modify its System for Measuring Individual Soldier Status. Report to the Secretary of the Army. March 30, 1982.

5. J. Johnson. Econometric Methods, 2nd Edition. New York: McGraw-Hill, 1972, pp. 278-291.

6. Ibid, pp. 285-286.

7. This was found in Roy Nord and Thomas V. Daula, Estimated Time to Promotion for Enlisted Soldiers, paper presented at The Information Management/Operations Research Society of America Conference, Boston, MA; July 1985.

8. Barry L. Scribner, D. Alton Smith, Robert H. Baldwin and Robert W. Phillips, Are Smart Tankers Better Tankers: AFQT and Military Productivity, Office of Economic and Manpower Analysis, Department of Social Sciences, United States Military Academy, December 1984. The paper is reproduced in the Report to the House and Senate Committees on Armed Services, Defense Manpower Quality, Volume II (Army Submission), May 1985 appendix C. Preliminary regression equations for the training and SQT data, generated by David K. Horne and Major Thomas V. Daula, are included in appendix E and appendix I of the same report.

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