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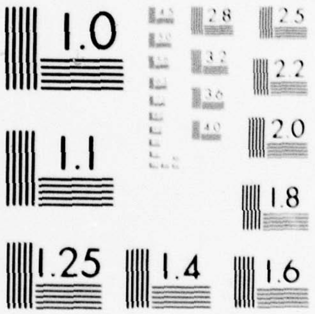

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THE EFFECTS OF MILITARY OCCUPATIONAL TRAINING ON CIVILIAN EARNINGS: AN INCOME SELECTIVITY APPROACH.

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THE EFFECTS OF MILITARY OCCUPATIONAL TRAINING ON CIVILIAN EARNINGS: AN INCOME SELECTIVITY APPROACH

BY R. P. TROST AND J. T. WARNER*

INTRODUCTION

There have been several studies on the returns to military occupational training. For examples of these studies see Cutright (1973), Jurkowitz (1969), Massell and Nelson (1974), Giesecke (1975), and Norrblom (1976). In these studies, the returns to military training are measured by the earnings differences between veterans who take civilian-related jobs (i.e., civilian jobs which are related to their military jobs) and similar veterans who take unrelated jobs. The usual procedure in these studies is to estimate dummy variable regression equations where earnings are regressed on several explanatory variables and a dummy variable which takes a value of 1 for veterans in related jobs and 0 for others.

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There are two self-selectivity problems that flaw the usual procedure. The first self-selectivity problem is that some veterans choose to work in related jobs while others do not. Although the usual procedure treats occupational choice as exogenous, it is really endogenous. The observed earnings differences between those who choose related jobs and those who choose unrelated jobs will not, in general, give unbiased estimates of the earnings effect of training.[1] One purpose of this paper is to test for this selectivity bias when analyzing veterans who were trained in electronics-related jobs while in the military.

A second selectivity problem also complicates the analysis of veterans' earnings. This is the occupational assignment process that occurs upon entering military service. New entrants are assigned to various military occupations on the basis of observable educational background and upon their preferences and other unobservable factors such as occupations

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[1] For discussions of the self-selectivity problem, see Heckman (1976) and Lewis (1974) in the context of labor supply, Lee (1976) in the context of unions and wages, Lee and Trost (1978) in the context of home ownership, Kenny et al. (1978) in the context of returns to college education, and Maddala (1977) for a survey of several problems involving self-selectivity.

available when they entered service. This occupational selection process may also distort post-service earnings comparisons. Below we present a procedure which corrects for both of these selectivity problems and provides unbiased estimates of the earnings effects of electronics-related training in the military. The model which we develop and estimate is a further generalization of the recursive models discused in Maddala and Lee (1976).

In analyzing the post-service earnings of a large cohort of military veterans, we divide the sample into four groups: (1) those who received training in electronics while in the military and also took civilian jobs in electronics after leaving military service; (2) those who did not receive electronics training while in the military but took civilian jobs in electronics after leaving ; (3) those who received training in electronics while in the military but did not take civilian jobs in electronics after leaving; and (4) those who neither received electronics training nor took civilian jobs in electronics. By using a two stage regression technique that takes account of selectivity bias, we predict the expected earnings of a typical veteran for each of these four groups. Of particular interest will be a comparison of earnings between groups 1 and 2. This will give us some measure of the returns to electronics - specific training (relative to non-electronics training) for the veteran taking a civilian job in electronics. We will also be interested in comparing the average earnings of groups 3 and 4, and groups 1 and 3. A comparison of groups 3 and 4 will give us some measure of the returns to non-electronics training (relative to electronics training) for the veteran taking a non-electronics job after leaving the service. Past studies have used the results of dummy variable regressions to make these comparisons. This is incorrect if there is any selectivity bias.

The rest of the paper is divided into the following sections. Section II discusses the data and the model to be estimated. Section III gives the estimation procedures and Section IV presents the empirical results and gives the conclusions.

II DATA AND MODEL

The data for this study consist of a sample of 11,941 enlisted veterans who left service in FY 1969 after one term of military service. Data on observed characteristics such as education level, mental ability as measured by Armed Services

Qualification Test Score (AFQT), race, length of military service, type of training, etc. are drawn from military service records. Each veteran's post-service occupation was determined from a survey conducted by the Department of Defense 10 months after the veteran left service. To determine whether the veteran was in a related civilian job, his three-digit civilian occupation code was matched with his two-digit military occupation code. The earnings data are drawn from social security earnings records. In the analysis below, earnings are the average of the veteran's social security (projected to an annual income in those few cases where earnings reached the social security maximum) earnings for the years 1970-1974.

The term "electronics training" is used in a loose sense here. There are eight major military occupation categories -- Infantry and Other Combat-Related (I), Electronics Equipment Repair (EER), Communications/Intelligence (C/I), Medical (M), Other Technical (OT), Electrical/Mechanical Equipment Repair (E/MER), and Supply/Service Handlers. In this study, we group those trained as Electronics Equipment Repair Specialists and Electrical/Mechanical Equipment Repair specialists into the category "received electronics training." This aggregate group comprises 41 percent of our sample.

We group these two broad categories of occupations together for several reasons. First, much of the training received in these two categories is very similiar. Second, they have many of the same related civilian jobs. Third, these are the two occupational categories where significant civilian-related job skills are likely to be acquired. This is true both because of the large percentage of veterans trained in these occupations and the fact that these occupations have many related civilian jobs. Clearly, the Infantry and other Combat-Related occupations provide little training that is readiliy transferrable to the civilian sector. Previous job training is a prerequisite for assignment to some of the other military occupations, such as the Other Technical occupations, and it is questionable whether new skills are actually being acquired here.

We want to calculate the potential earnings of a veteran for each of the four groups discussed in the introduction. To do this, we first define two indicies YM and YC. YM is defined as

$YM = 1$ if a veteran received training in electronics while in the military,

= 0 otherwise.

YC is defined as

YC = 1 if a veteran chooses to work in an electronics - related job after leaving the service,

= 0 otherwise.

So each veteran must fall into one of four distinct groups. Table 1 gives the number of observations in each of the four groups. Sixteen percent of those who were trained in electronics jobs in the military took related jobs in the civilian sector, whereas 12 percent of those trained in non-electronics jobs took electronics-related jobs in the civilian sector. The percent of veterans choosing related civilian jobs in our sample is similar to those found in the previously cited studies.

Since we are ultimately interested in calculating earnings differentials, table 2 gives the mean and standard deviation of the 1970-74 average earnings of each group. These data, by themselves, might imply a positive effective of military electronics training. Those individuals trained in electronics who chose civilian electronics jobs earned over $1,000 per year

(12.5 percent) more than similarly trained individuals who did not choose civilian electronics jobs. They earned over $400 per year (4.9 percent) more than those individuals who were not trained in electronics in the military but who subsequently chose civilian electronics jobs.

While on the surface the data indicate a positive effect of training, these averages do not tell us what the mean earnings of an individual in group i would have been if the earnings of all individuals had been observed in group i. To answer this question, we must first adjust for the fact that the individuals in these four groups may have different observed charateristics (education levels, mental abilities, and the like). Second, we must remove any possible selectivity bias. For example, those who selected civilian jobs in electronics presumably did so because they had some special "unobservable" abilities that made these jobs particularily appealing to them, like higher pay. The same can be said for the men who select non-electronics jobs. In the next section we show how to adjust for this selectivity bias in the context of a regression analysis.

The model we estimate has the following specification. Let YM* be an <u>unobservable</u> index whereby an individual is <u>chosen</u>

for military electronics training. Assume the military makes this choice based on a set of exogenous variables X_m. Then we have

$$YM^{\star} = \beta_m^{\star\prime} X_m - \varepsilon_m^{\star}, \tag{1}$$

where $\varepsilon_m^{\star} \sim N(0, \sigma^{\star}_m)$ and we observe

$$YM = 1 \text{ iff } YM^{\star} \geq 0.$$
$$= 0 \text{ otherwise.}$$

Let $YC^{\star}$ be an unobservable index whereby a veteran chooses to work in electronics after leaving the military. Assume this choice is based on YM and a set of exogenous variables $\tilde{X}_c$. Then we have

$$YC^{\star} = \tilde{\beta}_c^{\star\prime} \tilde{X}_c + \alpha^{\star} YM - \varepsilon_c^{\star}, \tag{2}$$

where $\varepsilon_c^{\star} \sim N(0, \sigma_c^{\star 2})$, YM is defined as in (1), $\tilde{X}_c$ contains all the variables in X_1, X_2, X_3, and X_4 below, as well as other variables, and we observe

$$YC = 1 \text{ iff } YC^{\star} \geq 0,$$
$$= 0 \text{ otherwise.}$$

Finally, define four earnings equations.

$$\begin{aligned} Y_1 &= \beta_1' X_1 + \varepsilon_1 \\ Y_2 &= \beta_2' X_2 + \varepsilon_2 \\ Y_3 &= \beta_3' X_3 + \varepsilon_3 \\ Y_4 &= \beta_4' X_4 + \varepsilon_4, \end{aligned} \tag{3}$$

where we only observe:

$$\begin{aligned} &Y_1 \quad \text{iff} \quad YM = 1;\ YC = 1 \\ &Y_2 \quad \text{iff} \quad YM = 0;\ YC = 1 \\ &Y_3 \quad \text{iff} \quad YM = 1;\ YC = 0 \\ &Y_4 \quad \text{iff} \quad YM = 0;\ YC = 0. \end{aligned} \tag{4}$$

We want to estimate the parameters

β_m, $\tilde{\beta}_c$, α , β_1, β_2, β_3 and β_4, where $\beta_m = \beta^*_m/\sigma^*_m$, $\tilde{\beta}_c = \tilde{\beta}^*_c/\sigma^*_c$ and $\alpha = \alpha^*/\sigma^*_c$.

In general, these parameters cannot be estimated by OLS. The reason for this is that the error terms $\varepsilon_1 \ldots \varepsilon_4$ do not have zero expectations, but are conditional on the choices that are made. In the next section we present these non-zero expectations, and we discuss a simple two stage estimation technique that gives consistent estimates of the parameters.

III. ESTIMATION PROCEDURE

In this section we show how to estimate the model given by equations 1-4 in section two. First we discuss the estimation of the two choice equations.

Assuming independence between ε_m^* and ε_c^*, equations 1 and 2 can be estimated by Probit analysis. The probit model assumes that the probability of YM = 1 or YC = 1 follows the standard normal cumulative function. So equations 1 and 2 are rewritten as the Probit models

$$YM = F(\beta_m' X_m) - \varepsilon_m \tag{1A}$$

and

$$YC = F(\tilde{\beta}_c' \tilde{X}_c + \alpha\, YM) - \varepsilon_c, \tag{2A}$$

where F is the standard normal cumulative function YM is defined as in (1). Both ε_m and ε_c are independent and distributed N(0,1).

In order to estimate the earnings equations given by equation 3 and 4 in section two, we need to take account of possible selectivity bias. The selectivity bias problem arises because ε_i, i=1, 2, 3, 4 may be correlated with both ε_m and ε_c.

For example, those veterans who choose to work in electronics may have higher expected incomes in the electronics field than a veteran "drawn at random". If this is the case, then the expectation of the disturbance term in the earnings equation for those veterans who choose (and therefore are observed in) civilian electronics occupations is nonzero and not constant for all observations.

Similarly, those individuals that were selected for electronics training may have been selected because of unobservable characteristics that may have made them better fit to receive this training (e.g. they expressed and interest in electronics training). Therefore, the error terms $\varepsilon_1 \ldots \varepsilon_4$ may also be correlated with the unobservable factors affecting the military occupational assignment process.

It may be shown that $\varepsilon_1 \ldots \varepsilon_4$ have the following expectations conditional on YM and YC:

$$E(\varepsilon_1 | YC = 1) = \sigma_{\varepsilon_1 \varepsilon_c} \frac{-f(\beta_c' X_c)}{F(\beta_c' X_c)} \qquad (5a)$$

$$E(\varepsilon_2 | YC = 1) = \sigma_{\varepsilon_2 \varepsilon_c} \frac{-f(\beta_c' X_c)}{F(\beta_c' X_c)} \qquad (5b)$$

$$E(\varepsilon_1 | YM = 1) = \sigma_{\varepsilon_1 \varepsilon_m} \frac{-f(\beta_m' X_m)}{F(\beta_m' X_m)} \tag{5c}$$

$$E(\varepsilon_3 | YM = 1) = \sigma_{\varepsilon_3 \varepsilon_m} \frac{-f(\beta_m' X_m)}{F(\beta_m' X_m)} \tag{5d}$$

$$E(\varepsilon_3 | YC = 0) = \sigma_{\varepsilon_3 \varepsilon_c} \frac{f(\beta_c' X_c)}{1-F(\beta_c' X_c)} \tag{5e}$$

$$E(\varepsilon_4 | YC = 0) = \sigma_{\varepsilon_4 \varepsilon_c} \frac{f(\beta_c' X_c)}{1-F(\beta_c' X_c)} \tag{5f}$$

$$E(\varepsilon_2 | YM = 0) = \sigma_{\varepsilon_2 \varepsilon_m} \frac{f(\beta_m' X_m)}{1-F(\beta_m' X_m)} \tag{5g}$$

$$E(\varepsilon_4 | YM = 0) = \sigma_{\varepsilon_4 \varepsilon_m} \frac{f(\beta_m' X_m)}{1-F(\beta_m' X_m)} \tag{5h}$$

where X_c includes $\tilde{X}_c$ and YM; and β_c includes $\tilde{\beta}_c$ and α. Proofs of these conditional expectations are found in a paper by Lee and Trost (1978), and will not be reproduced here. The term $f(.)$ is the standard normal density function, and $F(\beta_c' X_c)$ and $F(\beta_m' X_m)$ are the probabilities that YC = 1 and YM = 1, respectively.

Each of the various subscripted terms in (5) is the covariance between the error term in the choice equation and the given earnings equation. For example, $\sigma_{\varepsilon_1 \varepsilon_c}$ is the covariance between ε_1 and ε_c. Since the error term in equation 2 was written with a minus sign, a positive (negative) value of $\sigma_{\varepsilon_1 \varepsilon_c}$ indicates that those who are predicted to choose civilian electronics jobs <u>but do not</u> (i.e., $\varepsilon_c > 0$) will have on average higher (lower) earnings in electronics jobs than the earnings predicted by Y_1. Alternatively, a positive (negative) value of $\sigma_{\varepsilon_1 \varepsilon_c}$ indicates that those who are <u>not</u> predicted to choose civilian electronics jobs but do (i.e., $\varepsilon_c < 0$) will, on average, have lower (higher) earnings in electronics jobs than the earnings predicted by Y_1. A similar interpretation holds for $\sigma_{\varepsilon_2 \varepsilon_c}$, $\sigma_{\varepsilon_3 \varepsilon_c}$, $\sigma_{\varepsilon_4 \varepsilon_c}$, $\sigma_{\varepsilon_1 \varepsilon_m}$, $\sigma_{\varepsilon_2 \varepsilon_m}$, $\sigma_{\varepsilon_3 \varepsilon_m}$, and $\sigma_{\varepsilon_4 \varepsilon_m}$.

To see the expected relationship between the covariances, consider the following simple example. Suppose $\sigma_{\varepsilon_1 \varepsilon_c}$ and $\sigma_{\varepsilon_3 \varepsilon_c}$ are both positive. We want to compare the electronics and non-electronics earnings of men who were trained in electronics by the military. Positive values of $\sigma_{\varepsilon_1 \varepsilon_c}$ and $\sigma_{\varepsilon_3 \varepsilon_c}$ mean that those who were predicted to choose civilian electronics jobs but did not (i.e. $\varepsilon_c>0$), have on average, higher earnings than those predicted by both $\hat{Y}_1 = \beta'_1X_1$ and $\hat{Y}_3 = \beta'_3X_3$ in equation (3) (i.e. $\varepsilon_1>0$ and $\varepsilon_3>0$). Since these men do not choose electronics, then we should expect $\sigma_{\varepsilon_3\varepsilon_c} > \sigma_{\varepsilon_1\varepsilon_c}$. That is, these individuals choose to work in non-electronics jobs because they can earn more in non-electronics jobs than in electronics jobs. For the other covariance terms, the expected realtionships are

$$\sigma_{\varepsilon_4\varepsilon_c} > \sigma_{\varepsilon_2\varepsilon_c},\ \sigma_{\varepsilon_2\varepsilon_m} > \sigma_{\varepsilon_1\varepsilon_m} \text{ and } \sigma_{\varepsilon_4\varepsilon_m} > \sigma_{\varepsilon_3\varepsilon_m}.$$

In order to get consistent estimates of β_1, β_2, β_3, and β_4, we need to correct for the nonzero disturbance terms in the earnings equations. This is done by the two stage technique discussed in Heckman (1976) and Lee and Trost (1978). In the first stage we estimate equations (1a) and (2a) by Probit analysis, and create the variables

$$\frac{-f(\hat{\beta}'_cX_c)}{F(\hat{\beta}'_cX_c)},\ \ldots\quad \ldots\ \frac{f(\hat{\beta}'_mX_m)}{1-F(\hat{\beta}'_mX_m)},$$

where the carets (^) indicate estimated coefficients.

In the second stage we use OLS on the following four earnings equations.

$$Y_1 = \beta'_1X_1 + \sigma_{\varepsilon_1\varepsilon_c}\frac{-f(\hat{\beta}'_cX_c)}{F(\hat{\beta}'_cX_c)} + \sigma_{\varepsilon_1\varepsilon_m}\frac{-f(\hat{\beta}'_mX_m)}{F(\hat{\beta}'_mX_m)} + \eta_1 \qquad (6a)$$

$$Y_2 = \beta_2' X_2 + \sigma_{\varepsilon_2 \varepsilon_c} \frac{-f(\hat{\beta}_c' X_c)}{F(\hat{\beta}_c' X_c)} + \sigma_{\varepsilon_2 \varepsilon_m} \frac{f(\hat{\beta}_m' X_m)}{1-F(\hat{\beta}_m' X_m)} + \eta_2 \tag{6b}$$

$$Y_3 = \beta_3' X_3 + \sigma_{\varepsilon_3 \varepsilon_c} \frac{f(\hat{\beta}_c' X_c)}{1-F(\hat{\beta}_c' X_c)} + \sigma_{\varepsilon_3 \varepsilon_m} \frac{-f(\hat{\beta}_m' X_m)}{F(\hat{\beta}_m' X_m)} + \eta_3 \tag{6c}$$

$$Y_4 = \beta_4' X_4 + \sigma_{\varepsilon_4 \varepsilon_c} \frac{f(\hat{\beta}_c' X_c)}{1-F(\hat{\beta}_c' X_c)} + \sigma_{\varepsilon_4 \varepsilon_m} \frac{f(\hat{\beta}_m' X_m)}{1-F(\hat{\beta}_m' X_m)} + \eta_4 \tag{6d}$$

where the η's have zero means and equation (6a) only uses those observations where YC=1 and YM=1, equation (6b) only use those observations where YC=1 and YM=0, etc. The coefficients on the created variables are estimates of the covariances $\sigma_{\varepsilon_1 \varepsilon_c} \ldots \sigma_{\varepsilon_4 \varepsilon_m}$.

IV. EMPERICAL RESULTS AND CONCLUSIONS

This section discusses our empirical results. We first show the results of the usual procedure and then contrast these results with the procedure which corrects for selectivity bias. There are actually two "usual" procedures. One is to estimate a single regression which pools the data from all four cells and includes dummy variables for the military-civilian occupational categories. This procedure employs the implicit restriction that the exogenous variables in equations (4a)-(4d) have the same effect on earnings regardless of the type of military training received or the civilian occupation chosen (i.e., that the exogenous variables are all the same and that $\beta_1=\beta_2=\beta_3=\beta_4$). The coefficients on the dummies for the different military-civilian occupational categories provide estimates of the earnings effects of military electronics training.

Rather than estimating one pooled regression, one may estimate a separate OLS earnings equation for each of the four groups. This procedure is followed when there is a reason to suspect that $\beta_1=\beta_2=\beta_3\ \beta_4$. The equality of β_1, β_2, β_3, and β_4 can be tested by the usual F-tests.

Estimates of mean earnings differences between the four categories are derived from the estimated equations. Table 3 shows the results of the pooled OLS regression which includes dummy variables for group 1(YM=1;YC=1), group 2 (YM=0; YC=1), and group 3 (YM=1; YC=0). The omitted group is group 4 (YM=0; YC=0). Controlling for differences in observed characteristics, the estimated earnings differences between the various groups are somewhat smaller than the differences in the raw averages in table 2. Statistically significant differences are still estimated, however, between those who were in civilian electronics jobs and those who were not. Among those in civilian electronics jobs, those trained in electronics in the mlitary earned, on the average, $327 per year more than those who were not trained in electronics in the military. This difference, which is 3.5 percent of the average earnings of those in civilian electronics jobs, is the usual procedure estimate of the value of military electronics training.

The separate OLS equations for each of the four categories are presented in table 4. When separate regressions are estimated for each of the four categories, the effects of the various explanatory variables are found to be quite different.

In table 9 below, the equations in table 4 are used to derive earnings differences between the four different categories for individuals with similar attributes.

Tables 5 and 6 present the probit estimates of the YM and YC equations, respectively. The probability of receiving elecronics training in the military varies with branch of service, is higher for enlistees than draftees, is higher for whites, and rises with AFQT score. However, it varies inversely with education level, a result that at first may seem paradoxical. The largest difference among education categories is between those with more than 12 years and those with 12 years of education. Most of those with more than 12 years of education went into other occupational fields in the military, most frequently Communications/Intelligence, Medical, Other Technical, and Administrative/Clerical fields.

The YC equation includes the variables in the YM equation plus dummy variables for highest paygrade achieved in service and a dummy for military training in electronics. The probability of choosing a civilian electronics job varies significantly with branch of service, race, AFQT score, and type of military training, with those trained in electronics being more likely than others to choose such jobs in the civilian sector.

Let us look now at the two stage estimates of earnings equations (6a)-(6d), which are presented in table 7. Note that the estimated equations in table 7 omit some of the variables that appear in the choice equations. We have included in the earnings equations only variables that are thought to have an impact on earnings separate from their impact on the probability of being selected for electronics training or the probability of choosing a civilian electronics job. To include all variables in both the choice and earnings equations introduces a collinearity problem which we have sought to avoid.

Of immediate interest are the coefficients of the "missing variables" in the earnings equations, $\sigma_{\varepsilon_1\varepsilon_m} \ldots \sigma_{\varepsilon_4\varepsilon_c}$. Let us look first at the results on the four missing variables for civilian occupational choice in (6a)-(6d). All four of the covariance terms $\sigma_{\varepsilon_1\varepsilon_c} \ldots \sigma_{\varepsilon_4\varepsilon_c}$ are positive and statistically significant at the .01 level. That is, the error term in the YC equation is positively correlated with the error terms $\varepsilon_1 \ldots \varepsilon_4$ in the earnings equations (4a)-(4d).
Similarly, all four of the covariance terms $\sigma_{\varepsilon_1\varepsilon_m} \ldots \sigma_{\varepsilon_4\varepsilon_m}$ are

negative and, with the exception of $\sigma_{\varepsilon_2\varepsilon_m}$, are all statistically significant at the .01 level. That is, the error term in the YM equation is negatively correlated with the error terms $\varepsilon_1 \ldots \varepsilon_4$ in the earnings equations.

Two sets of covariances ($\sigma_{\varepsilon_4\varepsilon_c} > \sigma_{\varepsilon_2\varepsilon_c}$ and $\sigma_{\varepsilon_2\varepsilon_m} > \sigma_{\varepsilon_1\varepsilon_m}$) have the expected relationships discussed in section three. The other two sets of covariances ($\sigma_{\varepsilon_3\varepsilon_c} \cong \sigma_{\varepsilon_1\varepsilon_c}$ and $\sigma_{\varepsilon_4\varepsilon_m} \cong \sigma_{\varepsilon_3\varepsilon_m}$) do not have the expected relationships, but the estimated coefficients are almost equal. All in all, the estimated covariances support the notion that OLS estimates of the earnings equations are biased because of selectivity.

We now examine the predicted average earnings in the four categories for three different groups of individuals. These predictions are shown in table 8. Group 1 in table 8 is a low education - low mental ability group, group 2 is a medium education - medium mental ability group, and group 3 is a high education - high mental ability group. In all cases the individuals are assumed to be white. In addition, since the probit equations include some variables not included in the earnings equations, the two stage procedure also assumes the individuals reached the paygrade of E4, were enlistees, and were in the Air Force. For ease of comparison, differences in predicted earnings are shown in table 9, for each of the three methods and each of the three groups.

Examining table 8, compared with the pooled OLS and separate OLS procedures, in most cases the two-stage procedure gives lower estimates of average earnings in the four cells. Being conditional upon the occupational choices that were made, the sample average earnings in each cell overstate what average earnings would have been had everyone's earnings been observed in each cell.

The two stage procedure also reduces the estimated earnings differences between the four categories. In the case of group 1 in table 9, the estimated earnings difference between category 1,1 and 0,1 is virtually zero. Generally speaking, among those who were in civilian electronics jobs, the earnings difference between those who had military training in electronics and those who had not was negligible.

In the case of groups 1 and 3, among those who had military training in electronics, the two-stage procedure reduces by about half the estimated earnings difference between those who chose civilian electronics jobs and those who did not. That is, much of the observed earnings difference was due to selectivity bias. Since only 16 percent of those trained in military electronics jobs chose related civilian jobs, the finding that much of the observed earnings difference is due to selectivity bias has a great deal of intuitive appeal.

Except for group 3, the high education - mental abiltiy group, the two-stage procedure did not change very much the predicted earnings difference between category 1,1 and category 0,0. Among group 1 (low education - mental ability) individuals, those in category 1,1 earned 12.9 percent ($866/$6735) more than those in category 0,0. Among group 2 (median education - mental ability) individuals, the percentage difference was 7.4 percent ($623/$8447).

What do these results mean for the value of military occupational training? There are two questions we may ask here. First, does military occupational training add to human capital? Second, does that training yield a premium relative to other forms of human capital investment in the same stock of skills? The analysis of earnings of those in civilian electronics jobs provides an answer to the latter question. Over a five year interval, the average earnings of those who did not receive military training in electronics earned about as much as those who received this training. Presumably those who did not receive military training in electronics were acquiring human capital through other means (e.g., some type of unobservable formal training or OJT). Military training does not appear to yield a premium relative to these other forms of skill acquisition.

On the first question, the results are more mixed. Since only about 16 percent of recipients of electronics training take similar jobs, the extent of utilization is low.[2] Among this sixteen percent, however, military training may substantially improve their earnings above what they would have been had no training been received. The earnings of the 0,0 category provides an estimate of what earnings would be without training. Among the low and median education - mental ability groups in table 9, those who received training and used it in the civilian sector earned 7.4-12.9 percent more than those who did not receive electronics training and were in non-electronics jobs in the civilian sector.

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[2] This statement should be qualified. This low percentage of utilization is similar to those found in other studies of veterans <u>who serve one term of enlistment</u>. Among military careerists, we suspect that the utilization of military training in post-service jobs is higher, although we do not have the data to prove it.

One important aspect of military occupational training that may not be captured in an analysis of earnings, but nonetheless important, is that it gives veterans access to certain jobs for which they would otherwise not qualify. Employers may prefer to hire veterans who have certain job skills rather than having to hire and train unskilled individuals.

A final interesting question is whether occupational choice can be explained by the difference between the individual's earnings in electronics-related civilian jobs and non-electronics jobs. That is, can occupational choice be explained by $\Delta Y=Y_1-Y_0$, where Y_1 equals the individual's earnigns in electronics jobs and Y_0 equals the individual's earnings in non-electronics jobs? While either Y_1 or Y_0 is unobservable, the two-stage earnings equations can be used to predict the unobservable earnings. Doing this, and re-estimating the civilian

occupational choice equation with ΔY included, we obtained the results in table 10. ΔY is the most significant variable in the equation, and inclusion of ΔY reduced dramatically the statistical significance of the other variables below what they were in table 6. The probability of choosing a civilian electronics job is positively related to the difference between the individual's earnings in electronics jobs and earnings in non-electronics jobs. This result supports our assumption that individuals leaving the military do not randomly select careers, but choose to work in fields best suited to their abilities.

TABLE 1

NUMBER OF OBSERVATIONS, BY TYPE OF MILITARY TRAINING AND CIVILIAN OCCUPATION

Civilian Occupation	Military Training YM = 1	 YM = 0	Total
YC = 1	806	867	1673
YC = 0	4124	6144	10,268
Total	4930	7011	11,941

TABLE 2

AVERAGE YEARLY EARNINGS AND STANDARD DEVIATION OF EARNINGS 1970-74, BY TYPE OF MILITARY TRAINING AND CIVILIAN OCCUPATION*

	Military	Training	
Civilian Occupation	YM = 1	YM = 0	Marginal
YC = 1	9400 (2919)	8958 (2925)	9171 (2930)
YC = 0	8352 (2933)	8775 (3411)	8605 (3234)
Marginal	8524 (2956)	8798 (3355)	

---

*Standard deviations in parentheses.

TABLE 3

OLS EARNINGS REGRESSION WITH DUMMY VARIABLES*

Variable	Coefficients
Intercept	1106.64
AFQT	13.62 (10.57)
ED	522.11 (25.12)
White	586.43 (4.72)
D1(YM=1;YC=1)	695.19 (6.06)
D2(YM=0;YC=1)	368.47 (3.34)
D3(YM=1;YC=0)	-109.25 (1.76)
RSQ	.10512
Std. Error	3026.90
No. of Observations	11941
Mean of Dependent Variable	8684.77

---

*T-values in parentheses

TABLE 4

OLS EARNINGS EQUATIONS*

Variable	YM=1;YC=1	YM=0;YC=1	YM=1;YC=0	YM=0;YC=0
Intercept	2386.76	3404.63	2777.55	184.16
AFQT	21.19 (4.51)	23.17 (5.34)	10.91 (5.28)	13.80 (7.28)
Ed	427.29 (3.93)	297.71 (3.40)	404.73 (10.63)	587.21 (21.56)
White	650.93 (1.01)	793.74 (1.62)	301.37 (1.45)	709.89 (4.17)
RSQ	.06649	.07733	.05612	.12837
Std Error	2822.38	2811.77	2850.62	3185.22
No. of Observations	806	867	4124	6144

---

*t-value in parentheses

TABLE 5

PROBIT ANALYSIS ON THE DEPENDENT VARIABLE YM

Variable	Coefficient	t-value
Intercept	-.4617	6.38
Army	-.1343	2.80
Navy	.0852	1.65
Marine Corps	-.6753	7.78
Enlistee	.4306	14.20
Race	.1118	2.09
Ed < 11	.2193	5.50
Ed = 11	-.0269	.45
Ed > 12	-.7323	18.42
AFQT	.0020	3.65

Number of Observations = 11941

Number trained in electronics = 4903

Number not trained in electronics = 7011

-2x Log of Likelihood Ratio (df = 9) = 1034.132

Log of Likelihood function = -7577.5436

TABLE 6

PROBIT ANALYSIS OF THE DEPENDENT VARIABLE YC

Variable	Coefficient	t-Value
intercept	-1.5487	14.59
E4	.0632	1.14
E5	.1494	2.59
E6	.0544	.37
Army	- .1262	2.12
Navy	- .0259	.43
Marine Corps	- .2273	2.08
Enlistee	- .0432	1.12
Race	.1623	2.20
Ed < 11	.0201	.39
Ed = 11	- .0063	.08
Ed > 12	- .5126	10.18
AFQT	.0065	9.50
YM	.1038	3.43

Number of Observations = 11941

Number taking Civilian jobs in electronics = 1673

Number taking non-electronics civilian jobs = 10268

-2x Log of likelihood ratio (df=13) = 248.656

Log of likelihood function = -4713.6279

TABLE 7

TWO STAGE ESTIMATES OF EARNINGS EQUATIONS*

Variable	YM=1;YC=1	YM=0;YC=1	YM=1;YC=0	YM=0;YC=0
intercept	6871.97	7855.36	1189.68	- 248.14
AFQT	4.79	11.04	5.05	5.59
	(.64)	(1.74)	(1.50)	(2.04)
Ed	422.30	377.18	367.83	613.80
	(3.63)	(3.72)	(8.90)	(16.53)
White	1161.39	1065.85	444.95	889.79
	(1.75)	(2.13)	(2.05)	(5.02)
$\frac{-f(\hat{\beta}'_m X_m)}{F(\hat{\beta}'_m X_m)}$	-2028.69		-1243.01	
	(3.53)		(4.83)	
$-\frac{f(\hat{\beta}'_m X_m)}{1-F(\hat{\beta}'_m X_m)}$		- 961.35		-1390.30
		(1.54)		(4.96)
$\frac{-f(\hat{\beta}'_c X_c)}{F(\hat{\beta}'_c X_c)}$	3837.35	2689.92		
	(3.05)	(2.70)		
$\frac{f(\hat{\beta}'_c X_c)}{1-F(\hat{\beta}'_c X_c)}$			3754.57	5251.47
			(3.04)	(4.92)
RSQ	.07997	.08294	.06099	.13254
Std Error	2801.92	2803.20	2843.26	3177.61
No. of Observations	806	867	4124	6144

---

*The t-values in parentheses are slightly biased. See Lee, Maddala and Trost (1977) for a discussion.

TABLE 8

PREDICTED AVERAGE EARNINGS FOR GROUPS WITH THREE DIFFERENT SETS OF CHARACTERISTICS, AND OLS AND TWO-STAGE PROCEDURES

Category	1,1	0,1	1,0	0,0
GROUP 1[a]				
Pooled OLS	8,017	7,691	7,213	7,322
Separate OLS	7,946	7,870	7,453	7,180
Two-Stage	7,601	7,593	7,212	6,735
GROUP 2[b]				
Pooled OLS	9,335	9,008	8,530	8,639
Separqte OLS	9,224	8,929	8,481	8,630
Two-Stage	9,070	8,931	8,323	8,447
GROUP 3[c]				
Pooled OLS	10,129	9,802	9,325	9,434
Separate OLS	10,075	9,690	9,104	9,493
Two-Stage	9,335	9,068	8,891	9,137

---

[a] Group 1 has the following characteristics - AFQT = 30, Education = 10, race = white.

[b] Group 2 has the following characteristics - AFQT = 50, Education = 12, race = white.

[c] Group 3 has the following characteristics - AFQT = 70, Education = 13, race = white.

TABLE 9

DIFFERENCES IN EXPECTED EARNINGS FROM CATEGORY 1,1

Category	0,1	1,0	0,0
	GROUP 1		
Pooled OLS	-326	-804	-695
Separate OLS	- 76	-493	-766
Two-Stage	- 8	-389	-866
	GROUP 2		
Pooled OLS	-326	-804	-695
Separate OLS	-295	-743	-594
Two-Stage	-139	-746	-623
	GROUP 3		
Pooled OLS	-326	-804	-695
Separate OLS	-385	-871	-582
Two-Stage	-267	-444	-198

TABLE 10

PROBIT ANALYSIS ON THE DEPENDENT VARIABLE YC

Variable	Coefficient	t-value
intercept	-1.3214	11.82
E4	.0366	.66
E5	.0905	1.62
E6	.0248	.17
Army	- .0812	1.35
Navy	- .0054	.09
MC	- .1789	1.63
Enlistee	- .0148	.38
Race	- .0527	.65
Ed < 11	- .0985	1.79
Ed = 11	- .0478	.64
Ed > 12	- .1695	2.34
AFQT	.0031	3.58
YM	- .0353	.95
ΔY	.00038	6.42

Number of observations = 11941

Number taking Civilian jobs in elec. = 1673

Number taking non-electronics civilian jobs = 10268

-2xLog of likelihood ratio (df=14) = 290.294

Log of Likelihood function = -4692.8086

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