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ABSTRACT

A mathematical model was developed of military enlistment behavior based on the principle of occupational choice. A quality adjustment, applicable to all labor markets, was incorporated into the model in estimating the supply of volunteers. It was assumed that the greater the excess supply of volunteers, the greater the average quality of recruits. The adjusted supply curve took into account variations in the average quality of those who enlisted in the Air Force as a correction for unobserved variations in the excess supply. The increasing elasticity of supply with regard to the military-civilian earning ratio indicates that the universal military pay increases enacted by Congress will provide for an adequate supply of Air Force volunteers. Direct estimation of a supply curve on the observed values for employment by excluding a quality adjustment, when in fact excess supply exists, leads to an underestimation of the true elasticity of supply. Five tables present the data. (Author/AG)

# OCCUPATIONAL CHOICE, THE DRAFT, AND THE EXCESS SUPPLY OF AIR FORCE VOLUNTEERS

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# OCCUPATIONAL CHOICE, THE DRAFT, AND THE EXCESS SUPPLY OF AIR FORCE VOLUNTEERS

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In the "classical" theory of labor markets the interaction of the demand for labor and the supply of labor determines the number of individuals employed and their respective wage rates. Given perfect knowledge and flexible wages, firms are indifferent to hiring individuals of differing ability as long as the wage of each reflects his particular marginal productivity. In this type of market one would expect wages to vary, but would not expect unemployment or excess supply of labor. However, perfect knowledge and flexible wages do not usually exist, whereas unemployment does. This observation leads one to consider the "queue" approach to labor markets. According to the "queue" concept of labor markets, wages are attached to jobs and these jobs are rationed among those seeking work according to the employers' preferences. If the supply of labor exceeds the employers' demands, the employers will attempt to hire only the "better labor" (defined by the employer) at the established wage. On the other hand, if the employers' demand for labor equals or exceeds the available

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supply, all the labor will be hired. Thus in the case of excess supply, the labor which is hired will on the average be "better" than in the case in which excess supply did not exist.

Traditionally the supply curve representing all of the available labor at each wage assumes a constant average quality of labor. When an excess supply exists at a given wage, the employers, by being able to hire the "better labor," obtain a smaller labor force of higher average quality. This smaller amount of labor will lie to the left of the supply curve of all available labor. However we can define another supply curve of higher average quality such that the smaller amount of labor will just be supplied at the given wage. This latter curve will clearly lie above and to the left of the supply curve representing all available labor; and the greater the excess supply, the greater will be the difference between the average qualities of the two curves.

Because of the institutional makeup of the Armed Forces of the United States, the market for labor, called volunteers, experienced by the individual armed services can be characterized precisely by the "queue" concept.

Volunteers to all services in the military face a set wage determined by Congress. Each service would like to recruit (i.e., hire) the better volunteers, that is, those with the higher scores on their Armed Forces Qualification Tests. Since the Army has not enjoyed an excess supply of volunteers it has been forced to accept all volunteers above a minimum quality level. On the other hand, the Air Force has usually had an excess supply and hence has been able to select the better volunteers. As we will show later, the quality of the selected volunteers can be defined in terms of their qualification test scores and the average quality of the volunteers varies with the magnitude of the excess supply.

In fact, historically, the Air Force has had an easier task recruiting enlisted men than the Army. The Air Force has tended to be a more attractive service due to its element of lower risk, its opportunities for transferable training, and its general appeal to youthful adventure. For the most part, these characteristics together with the relatively smaller requirements of the Air Force have generated an excess of volunteers, obviating the need for drafting young men into the Air Force. Some of the excess supply can be strictly attributable to youth who want to avoid military service in the Army: rather than be drafted, they enlist in the Air Force, but still prefer civilian life to military life.

Because the impact of the draft on the number of volunteers to the Army as well as to all the military is considerable, previous studies by Altman [1], Altman and Fechter [2], Fechter [5], Fisher [6], Hause and Fisher [7], and Oi [9] have focused on the recruiting problems of the military in a "no draft" world. The size of the Army relative to the other military services has made it an appropriate target for the majority of the analysis. Since the demand for military manpower is perfectly inelastic in the short run, these studies have concentrated on supply effects, specifically on the estimation of the relevant supply curve in terms of its pay elasticity. Thus, Altman and Fechter [1] obtained an Army pay elasticity of supply equal to

1.17, Altman [2] a pay elasticity for the total military of 0.8 and Oi [8] an initial pay elasticity for Army enlisted personnel of 1.36.

None of these studies, however, determined a specific supply curve for the Air Force. Although the excess supply enjoyed by the Air Force indicates that the estimation of its supply curve has not been of immediate importance, it is not obvious that the excess supply will continue to exist in a "no draft" world. Hence it is important to know the nature of the supply curve specific to the Air Force.

The supply curve of Air Force volunteers, however, is not directly observable because data are not available on the number of individuals who volunteer but only on the number who actually enlist (that is, the number of volunteers who are accepted into the Air Force); so attempts to estimate supply curve parameters in traditional ways yield erroneous results. To circumvent this difficulty, we develop a supply curve adjusted by the quality of the recruits and demonstrate that this quality adjustment is an implicit equilibrating mechanism between the demand for recruits and the supply of volunteers. It will be shown that the parameters of the unobservable supply curve can then be inferred from the adjusted supply curve.

To determine the supply curve of Air Force volunteers, we construct an occupational choice model describing a youth's decision to enlist as a function of the net advantage of Air Force life with respect to civilian life. We introduce explicitly the draft pressures that might induce him to enlist in the Air Force rather than chance being drafted into the Army or Marines.

The model is presented in Section I. The quality adjusted supply curve that the model yields is integrated into the analysis; and the relationship of this curve to the "true" (but not observable) supply curve is described. In Section II we deduce an estimation equation. Section III defines the relevant variables used to specify the supply curve, and Section IV presents the results of the statistical estimation of the supply curve parameters. Section V reiterates the results and sets down the implications of the study.

## I. AN OCCUPATIONAL CHOICE MODEL

The enlistment decision can be viewed as a problem of occupational choice. Every individual is assumed to have the choice of two occupations either military or civilian, where the length of time spent in the occupation is four years--the standard term of enlistment for airmen in the Air Force. Initially each individual surveys the occupations open to him and considers the advantages and disadvantages of each, such as expected earnings, expected advancement, working conditions, perquisites, and location. We assume then that each individual's choice of occupation is based on the concept of utility maximization. If the utility of military pecuniary and nonpecuniary advantage exceeds the utility of civilian pecuniary and nonpecuniary advantages, the individual enlists, but if civilian benefits exceed military benefits, he remains a civilian.

At any given point in time, t, the person contemplating enlistment in the Air Force can expect a stream of pecuniary benefits $V^m_{t1}, \ldots, V^m_{ts}$ for s periods of military service or a stream $V^c_{t1}, \ldots, V^c_{ts}$ for s periods of civilian life. At the same time this person can expect a stream of nonpecuniary benefits $N^m_{t1}, \ldots, N^m_{ts}$ for s periods of military service or a stream $N^c_{t1}, \ldots, N^c_{ts}$ for s periods of civilian life.

Each of these streams can be discounted over the relevant time period (four years, the standard enlistment term, in our analysis) to obtain expected pecuniary benefits for military and civilian life, $V^m$ and $V^c$ respectively, and expected nonpecuniary benefits $N^m$ and $N^c$ for military and civilian life respectively. Moreover we assume that each potential enlistee monetizes his expected military nonpecuniary benefits (which may be negative) and his expected civilian nonpecuniary benefits. The valuation rates for military and civilian nonpecuniary benefits are $r^m$ and $r^c$ respectively where the rates differ for each individual. The marginal rate of substitution of pecuniary benefits for nonpecuniary benefits is equal to the marginal utility of the nonpecuniary benefits divided by the marginal utility of the pecuniary benefits. In equilibrium under utility maximization this ratio is equal to the ratio of pecuniary benefits to the valuation of nonpecuniary benefits. The valuation factors can then be written as:

(1) $$r^m = (MU(V^m)/MU(N^m))V^m; \qquad r^c = (MU(V^c)MU(N^c))V^c \, .$$

After monetizing nonpecuniary benefits, total expected benefits of enlisting are $V^m+r^mN^m$ for each individual, and the total expected benefits of not enlisting are $V^c+r^cN^c$. However an individual associates some risk with each set of benefits. One risk is that of being unemployed in the civilian economy whereas military life is relatively secure. This risk is explicitly considered in the estimation to ascertain if in fact unemployment has a direct effect on enlistments. Some will also associate with enlistment in the Air Force a certain degree of risk with respect to death. This probability of not surviving lowers the total expected benefits of military service and the total expected benefits of civilian occupations subsequent to military service. However the probability of not surviving the first term of enlistment (our frame of reference) in the Air Force is sufficiently small that the expected benefits of military service need not be adjusted by this probability.

In deciding whether to enlist, each individual selects that occupation which offers the highest set of benefits based on the expected pecuniary benefits, the expected nonpecuniary benefits, and his particular valuation of nonpecuniary benefits. That is, the individual enlists if

$$V^m + r^m N^m > V^c + r^c N^c \quad (2)$$

However, the decision rule can be rewritten as

$$V^m(1+(MU(V^m)/MU(N^m))N^m) > V^c(1+(MU(V^c)/MU(N^c))N^c) \quad (3)$$

or

$$V^m > V^c \left[\frac{1+(MU(V^c)/MU(N^c))N^c}{1+(MU(V^m)/MU(N^m))N^m}\right] . \quad (4)$$

The term in brackets in the above equation clearly varies with differing amounts of pecuniary and nonpecuniary benefits but we assume that it can be simplified to

$$\frac{1+(MU(V^c)/MU(N^c))N^c}{1+(MU(V^m)/MU(N^m))N^m} = 1 + z \quad (5)$$

reflecting each individual's preferences for military relative to civilian life. The individual is then indifferent when $V^m = (1+z)V^c$. Accordingly, each individual makes his decision on the basis of his net preference (or aversion) for military service, a process which reflects his particular taste. While we cannot measure his tastes directly, we can observe his decision and we can relate variations in enlistment behavior of many individuals to variations in the present values of military and civilian earnings. If we define $\hat{V}^c = (1+z)V^c$ as a "reservation" value, an individual will volunteer when the present value of military earnings exceeds his particular "reservation" value. At any given ratio $V^m/V^c$, we can observe a certain number of individuals volunteering. As this ratio rises, more individuals will be compensated enough to volunteer, and conversely. as the ratio declines, fewer individuals will be compensated enough to volunteer. The relationship of variations in this ratio to variations in the number of volunteers will generate an aggregate supply curve of volunteers to the Air Force where in the traditional way the supply curve represents volunteers who are assumed to be homogeneous with respect to quality.

## The Supply of Volunteers

However, the volunteers are not homogeneous. In terms of the ability or quality (as measured by the Armed Forces Qualifying Test (AFQT) scores) of volunteers who are accepted, the average quality has varied considerably with the conditions existing at specific times. The reasons underlying the variation become quite clear if we consider the process by which the Air Force obtains the volunteers it demands.

The Air Force has in the presence of the draft historically faced an excess supply of volunteers in terms of its requirements. As a result, it has always met its manpower requirements, and in so doing has sought to enlist the better volunteers, i.e., those with the highest AFQT scores.* The volunteers are ranked ordinally by their respective AFQT scores, which classify individuals into the five categories in Table 1, where Category 1 represents those who score highest on the AFQT and Category 5 those who score lowest. In actual practice, Category 5 individuals do not meet the minimum standards and are refused enlistment. For recruting purposes, Category 1 is preferable to Category 2, Category 2 to Category 3, and Category 3 to Category 4.

Table 1

AFQT CATEGORIES

| Category | Raw Score | Percentile Score | Midpoint (Percentile Score) |
|---|---|---|---|
| 1 | 89-100 | 93-100 | 96.5 |
| 2 | 74-88 | 65-92 | 78.5 |
| 3 | 53-73 | 31-64 | 47.5 |
| 4 | 25-52 | 10-30 | 20.0 |
| 5 | 9-24 | 0-9 | 4.5 |

The traditional supply curve represents the total number of men who volunteer at specific levels of the net advantages of military to civilian life. The correct supply specification, however, must explicitly consider the numberoof men *at each quality level* who

* This is known as "creaming," which is not a rigorous process. Recruiters naturally prefer better applicants to poorer ones, but in terms of the stochastic arrival of volunteers to the many recruiting centers, they undoubtedly accept less qualified men in the face of the uncertain arrival of more qualified ones.

volunteer at specific values of the net advantages, i.e., the distribution of volunteers across the quality spectrum (0 to 100) for the different net advantages.

This quality, as given by the AFQT scores, can be represented by Fig. 1, where q denotes the level of quality, bounded above by 100 (a perfect score) and below by 0, and y the number of volunteers at each quality level deflated by the eligible population. The Air Force has instituted a minimum AFQT score of 24 and accepts no person scoring lower. The *total* volunteer rate, Y, of individuals specified for service in the Air Force, at a given earnings ratio, is given by the area under the curve to the right of 24, that is,

$$Y = \int_{24}^{100} f(q)\, dq \ , \qquad (6)$$

where f(q) represents the distribution of volunteers (deflated by the eligible population) in Fig. 1.

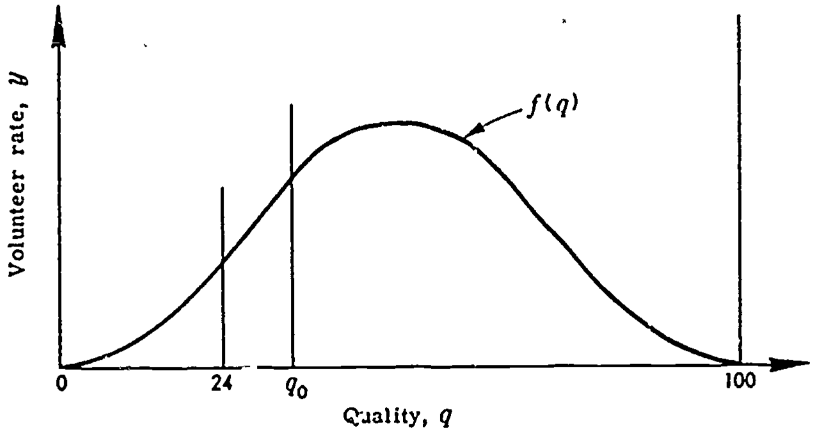


Fig. 1—Distribution of volunteers by quality

As the earnings ratio $V^m/V^c$ increases, we assume that the number of volunteers at each quality level increases and hence the total number of volunteers increases. If we assume that a function H(E,q), where $E = V^m/V^c$, can be defined such that

$$Y = \int_{24}^{100} H(E,q)f(q)\,dq \tag{7}$$

where $\partial H/\partial E > 0$ for all q, then the total supply of volunteers can be written as a function of the earnings ratio, given the distribution, f(q).

However, the total number of volunteers are not actually observed. Given the excess supply, manpower requirements (volunteers demanded) are satisfied by first accepting the better volunteers and then the poorer ones.* A rigorous "creaming" process implicitly identifies a minimum quality level, $q_o$, of accepted volunteers, where $q_o \geq 24$. What is observed is the "accepted" volunteer rate, $Y_A$, which can be written as

$$Y_A = \int_{q_o}^{100} H(E,q)f(q)\,dq \ , \tag{8}$$

where the properties of H(E,q) and f(q) are the same as above.

Thus, because the Air Force can "cream" the excess supply of volunteers, it varies the quality of its recruits (the accepted volunteers) in satisfying its short-run demand. The variation in the average quality of the recruit force can be viewed as an implicit equilibrating mechanism between the true supply of volunteers and the demand.

The fixed demand for recruits and the actual supply curve of all volunteers define an equilibrium earnings ratio $E^*$. Clearly at a higher earnings ratio, we would observe an excess supply with respect to all available volunteers. However, at this higher ratio, there exists a quality level of the recruit force such that the excess supply is eliminated and the Air Forve volunteer market is in equilibrium. Essentially at this higher earnings ratio, the Air Force is more selective and raises its implicit recruiting standards. The resultant higher quality recruit force can be represented by a "quality adjusted" supply curve which lies to the left of the actual supply curve at all levels and is such that the excess supply is just eliminated.

## II. THE SUPPLY CURVE

The model described in Sec. I was developed in terms of traditional occupational choice. The resultant supply curve represents the supply of volunteers with respect to the net advantages of military service to civilian life after adjusting for quality and holding other factors constant. However, these other factors, especially the unemployment rate and the effect of the draft, are important in that they shift the distribution of volunteers, f(q) of Fig. 1. As draft pressure* increases, we should observe two effects: 1) some young men will seek to remove themselves from the imminent "danger" of being drafted by obtaining exemptions from military service; and 2) some young men will volunteer for the Air Force in order to complete their military service commitments without the risk associated with service in the Army and in order to obtain more relevant training during their military service.

Similarly, as unemployment increases in the age group most likely to be drafted, some of these individuals will prefer to volunteer for military service, specifically in the Air Force, to avoid the chance of earning nothing in civilian life and to obviate the possibility of being inopportunely drafted. This effect should shift the curve f(q) upwardly in Fig. 1 and to provide more Air Force volunteers. Although this effect is captured somewhat in the net advantages of military versus civilian life, a more complete specification requires inclusion of this separate unemployment effect.

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*The term "draft pressure" represents those policies of the Selective Service System that precipitate an enlistment decision by young men prior to their disposition to do so.

The effects of the draft, D, and unemployment, U, can be incorporated into the specification of the supply curve. Let W(E,D,U,q) be a function like H(E,q) above, which modifies the distribution of volunteers such that $\partial W/\partial E$, $\partial W/\partial D$, $\partial W/\partial U > 0$. The accepted volunteer rate may then be written as

(9) $$Y_A = \int_{q_o}^{100} W(E,D,U,q) f(q)\, dq \ .$$

Although the function W(·) is probably very complicated, the supply curve can be estimated empirically if we assume that W(·) is homogeneous and can be decomposed into its separate arguments. Let us assume that the function W(·) can be decomposed such that W(·) = h(E)m(D)n(U), where each component shifts f(q). Each component can be written as a monotonic function, homogeneous of some degree (not necessarily equal) in its argument. Thus

(10) $$Y = \int_{24}^{100} h(E)m(D)n(U)f(q)\, dq$$

can be written as

(11) $$Y = \int_{24}^{100} xE^a D^b U^c f(q)\, dq$$

$$= xE^a D^b U^c \int_{24}^{100} f(q)\, dq \ ,$$

where $H(E) = AE^a$, $m(D) = BD^b$, $n(U) = CU^c$, and $x = ABC$.

Equation (11) is the actual supply curve of total volunteers deflated by the eligible population. Although the number of total volunteers cannot be observed, the number of volunteers who are accepted for enlistment in any one period is known and is given by

$$(12) \qquad Y_A = \int_{q_o}^{100} E^a D^b U^c f(q)\, dq$$

$$= E^a D^b U^c \int_{q_o}^{100} f(q)\, dq \ ,$$

where $Y_A$ denotes the number of accessions (i.e., actual recruits) deflated by the eligible population and $q_o$ is the minimum quality level of the accessions. Equation (12) is the supply curve of volunteers adjusted for the minimum quality of the recruits. Moreover, the parameters associated with relative net advantages, draft pressure, and unemployment in (12) are identical to those in (11).

The minimum quality level $q_o$ cannot be observed either; but the average quality level of the recruits accepted can be observed. This average quality defined in terms of $q_o$, holding the other factors constant, is

$$(13) \qquad Q_A = \int_{q_o}^{100} qf(q)\, dq \ .$$

The Armed Forces Qualifying Test can be used to define $q_o$ implicitly and $Q_A$ explicitly. All individuals must take the AFQT and then are ranked in terms of their scores in a Category as represented in Table 1, p. 9.

If we let $q^*$ be the percentile score corresponding to the raw score q, the average quality of the accepted volunteers becomes

(14) $$Q_A = \int_{q_o}^{100} qf(q)\ dq = \int_{q_o^*}^{100} q^* f^*(q^*)\ dq^* .$$

The curve from Fig. 1 is thus transformed to the uniform distribution represented by $f^*(q^*)$. We can observe, then, the number of individuals in each category as the area under $f^*(q^*)$ for that category. By setting $q_i^*$ equal to the midpoint percentile score of the $i^{th}$ category, we obtain $Q_A$:

(15) $$Q_A = \int_{q_o^*}^{100} q^* f^*(q^*)\ dq^* = \sum_{i=1}^{5} q_i^* N_i ,$$

where $N_i$ represents the fraction of total recruits in the $i^{th}$ category.*

For an increase in $q_o^*$, given a fixed level of $W(\cdot)$ and fixed parameters of $f^*(q^*)$, the number of accepted volunteers declines. In other words, as the average quality of recruits increases (for fixed $W(\cdot)$ and $f^*(q^*)$), the number of accepted volunteers decreases. Thus, the number of accessions changes inversely at some rate r as the average quality of accessions, $Q_A$, varies, *ceteris paribus*. Hence, we can write the number of accessions deflated by the eligible population $Y_A$, as**

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*The Air Force recruit distributions by AFQT were supplied by Alan Fechter of the Institute for Defense Analyses; they were originally compiled by the U.S. Army Recruiting Command as reported by the Armed Forces Examining and Entrance Stations.

**Equation (16) may be deduced as follows from Eqs. (12) and (15). Since the parameters of $f^*(q^*)$ are assumed fixed and $q_o^*$ is assumed to be variable, the integral in (12) can be written as a function of $q_o^*$:

$$T = \int_{q_o}^{100} f(q)\ dq = \int_{q_o}^{100} f^*(q^*)\ dq^* = \xi(q_o^*) .$$

(16) $$Y_A = XE^aD^bU^cQ_A^r ,$$

where $X = x\ell$ is a constant, $\ell$ being a scale effect of the average quality level. This equation can then be rewritten in a suitable estimation form:

(17) $$\ell n\ Y_A = \ell n\ X + a\ \ell n\ E + b\ \ell n\ D + c\ \ell n\ U + r\ \ell n\ Q_A ,$$

an equation linear in the logarithm of each variable. From this equation, we can directly estimate a, the pay elasticity of supply for total volunteers.

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Similarly, (15) can also be written as a function of $q_o^*$:

$$Q_A = \int_{q_o^*}^{100} q^* f^*(q^*)\ dq^* = w(q_o^*) ,$$

where the average quality of accessions depends on the implicit lower bound, $q_o^*$ of the recruiting standards. For a given function $f^*(q^*)$, as $q_o^*$ is raised fewer volunteers will be accepted; those accepted will have higher values of $q^*$, implying an increase in $Q_A$. Given the parameters of $f^*(q^*)$, however, w is a one-to-one function over the values of $q_o^*$, and hence

$$q_o^* = w^{-1}(Q_A) = W(Q_A) .$$

We can now write the integral form in (12) as a function of $Q_A$:

$$T = \xi(q_o^*) = \xi(W(Q_A)) .$$

Since $dT/dq_o^* < 0$ and $dq_o^*/dQ_A > 0$, then $dT/dQ_A < 0$. We can now assume

$$T = \ell Q_A^r ,$$

where $r < o$. Hence we can formulate Eq. (16) from Eq. (15) with the above result.

## III. THE DATA

We estimated Eq. (17) by an ordinary least squares (OLS) regression using quarterly time series data from the first quarter of 1958 through the second quarter of 1967. In this estimation we used the following empirical measures of the variables.

### THE ACCEPTED VOLUNTEER RATE: $Y_A$

The number of volunteers accepted is the total number of enlistments from Categories 1, 2, 3, and 4. No enlistments from Category 5 are accepted. The population base used to deflate enlistments is the number of civilian, noninstitutionalized males, 16-20 years of age. The actual data, which were published in the *Manpower Report of the President*,* have been adjusted to represent the proportion of the population that is mentally qualified for service in the Armed Forces.

### NET ADVANTAGES: E**

The net advantages that determine individual enlistment preferences were defined in the first section as $E = V^m/\hat{V}^c = V^m/(1+z)\cdot V^c$, where $V^m$ represents the present value of the income received during the first term of Air Force enlistment, $V^c$ is the present value an individual could receive in the civilian economy, and (1+z) is the compensation factor associated with the enlistment decision.

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*Manpower Report of the President, U.S. Department of Labor, U.S. Government Printing Office, Washington, D.C., April 1968.

**Pecuniary military benefits and pecuniary civilian benefits are constructed in detail in the Appendix.

Pecuniary Military Benefits

To construct the pecuniary military benefits, $V^m$, of first-term enlistment, we combined expected Congressional pay changes by rank and years of service with observed changes in promotion rates for each point in time. Subsequent discounting at a 20 percent rate of time preference* yielded the perceived value of the pecuniary advantage of a four-year Air Force enlistment.

Pecuniary Civilian Benefits

To construct the pecuniary civilian benefits $V^c$, we have combined the age specific income, and the changes therein during the period 1959 to 1967,** with the observed age distribution of airmen enlistees.*** Both the changing age distribution of airmen enlistees and the changing distribution of civilian pay by age affect the aggregate expected pay that these enlistees forego in the civilian sector.

Net Advantages

The calculation of net advantages E is then the ratio of $V^m$ to $\hat{V}^c$; that is,

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*It is not clear what the proper discount rate for youths 16-20 is. However, there is evidence that the appropriate discount rate is somewhere between 18 and 25 percent, as indicated in R. Chaney, *Discounting by Military Personnel by Various Ages*, an unpublished Defense Department Study of Military Compensation, October 1962.

**The U.S. Bureau of the Census published male income figures for the age groups 14-19 years and 20-24 years. We included this data in the Appendix together with weekly earnings data for production workers in manufacturing industries.

***This distribution is given in the Appendix.

(18) $$E_{jk} = \frac{V^m_{jk}}{\hat{V}^c_{jk}} = \frac{V^m_{jk}}{V^c_{jk}(1+z)}$$

In terms of Eq. (17) we have*

(19) $$\ell n\ E^a = a\ \ell n \left(\frac{V^m}{V^c}\right) - \ell n\ (1+z)^a ,$$

and the term $\ell n\ (1+z)^a$ is constant.

DRAFT PRESSURE: D

The effect of the draft, that is draft pressure, on the enlistment decisions of young men is an elusive concept. Because of their preferences, individuals react differently to rapid increases in miliatary manpower procurements. Previous studies have either neglected the effect of draft pressure on the aggregate enlistment behavior of young men [1,2,9] or have couched the draft pressure effect in the ratio of

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*The present value of pecuniary net advantages is calculated solely for military base pay and does not include subsistence and other pecuniary allowances. If the assumption is made that these allowances are a constant proportion $\lambda$ of military base pay, then $V^m$ as calculated is an understatement on the order of $(1+\lambda)V^m - V^m$. The true value of $E^a$ should be $[(1+\lambda)V^m/(1+z)V^c]^a$. In our formulation, however, this reduces to

$$\ell n\ E^a = a\ \ell n \left(\frac{V^m}{V^c}\right) + \ell n \left(\frac{1+\lambda}{1+z}\right)^a .$$

As we describe later, this indicates that the marginal percentage change in volunteers due to a percentage change in net advantages is the same regardless of whether or not total benefits are included. On the other hand, additional allowances represent a declining proportion of military base pay over time, hence our estimated response of the volunteer rate with respect to changes in net advantages is an understatement of the true response and can be considered a conservative estimate.

inductions to the total population of young men [6]. This single variable, however, fails to consider two opposite effects of the draft; young men either seek to avoid induction altogether or they enlist to obtain the benefits which cannot be acquired by draftees. Our draft pressure measures attempt to capture these two separate effects. But although these measures are better than previous ones used in supply studies, they still cannot be considered infallible. A brief review of the Selective Service process facilitates the understanding of these two draft pressure measures.

The effect of the draft can be specified in terms of the actual process that results in inducting individuals into the Armed Forces or in its avoidance. All males are obligated to register with the Selective Service System on their eighteenth birthday. Those who have good cause are placed in a classification status termed "exempt" (i.e., ineligible for induction while so classified. Such exemptions have traditionally been given to those who are mentally insane, divinity students, sole surviving sons, farmers, and students still in high school. All others are classified as I-A.

An individual cannot be inducted from the I-A category without an examination, prior but close to his potential induction date. He receives a notice to report to an Armed Forces Examination and Entrance Station (AFEES) thus heralding the fact that he is being considered for possible induction into the Armed Services. During these "preinduction" physical examinations, some young men are eliminated from consideration for mental, moral, or physical reasons, based on standards instituted by the Selective Service System. Those who pass this examination can expect to be inducted into the Service sometime soon depending on the particular urgency and demands of the moment. They are classified as "I-A, examined and qualified." All inductees are drawn from this group. An empirical formulation of draft pressure should approximate the dynamic aspects of this induction process that forces some young men to seek options that delay or avoid induction. Two rather broad components of this draft pressure can be identified.

First, there are those who have already received their preinduction examination and are classified as "I-A, examined and qualified." These men face imminent Army induction. The pressure on those who are subsequently unable to acquire deferments may precipitate an enlistment decision. Some individuals may enlist in the Army; while others who wish to avoid Army induction may seek enlistment in the Air Force over the Army. However, the individuals who face induction, many fall into two groups: those who have elected not to seek other options and those who have been unable to do so. The latter reflect individuals who are probably ranked in the lower part of the queue with respect to quality and desirability and, because of the Air Force's creaming process, will probably not affect total volunteers in the relevant range. The former show some preference for, or resignment to, Army life and would, if anything, tend to decrease the number of volunteers to the Air Force. This component of draft pressure can be expressed as a ratio:

(20) $$D1 = \frac{I}{EAQ},$$

where I denotes the total inductees in any one period and EAQ the number of young men examined and found morally, mentally, and physically capable of serving in the armed forces, but not yet inducted.

Second, there is the draft pressure felt by those individuals who are classified as I-A, but have not been notified to report for their preinduction physical examination. The draft pressure on this group increases as the eligible pool of young men shrinks (as the individuals obtain deferments) and as men are called for their "preinduction physicals" at an increasing rate. This increased draft pressure forces young men to seek deferments removing them from the eligible pool. As the eligible pool shrinks, the average age of those called for the preinduction physicals falls and hence so does the average induction age. This does not mean that the number of volunteers necessarily declines. The persons who actively remove themselves from the eligible pool do so because they may not wish to make the decision between military and civilian life at that particular time.

In one sense the more qualified youths (i.e., the older ones, those with higher education, or those with more job experience) are the most likely to obtain deferments. They are also most likely to be acceptable to the Air Force and hence enlistment is a strong option.

We can define this pressure also as a ratio,

$$D2 = \frac{PPE}{IAP}, \tag{21}$$

where PPE denotes the youths who are called for a preinduction physical examination in any one period and IAP the number of youths in the I-A pool who have not yet been examined.

The data for I, EAQ, PPE, and IAP are published in the Annual Reports of the Director of Selective Service to the U.S. Congress. To correctly assess the different aspects of draft pressure, the two components defined above are treated as separate variables in the estimation.

UNEMPLOYMENT: U

As mentioned above, changes in the unemployment rate should cause similar changes in the number of volunteers to the Air Force in each mental category. If the unemployment rate is higher and less stable for lower quality groups of individuals, however, then changes in the unemployment rate may yield only modest (and perhaps negligible) changes in the number of volunteers on the relevant portion of the quality spectrum because of the creaming process used by the Air Force. This effect can be assessed by the results of the estimation. The unemployment rate U is the seasonally unadjusted unemployment rate for males, age 16-20. These statistics were supplied by the Bureau of Labor Statistics from unpublished data.

DUMMY VARIABLES

In addition, we have introduced three dummy variables into the analysis to account for certain changes during the 1959 to 1967 period, which are exogenous to the model but may have had a significant impact on the individual's enlistment decision. The use of these dummy variables assumes that the enlistment response to changes in the ratio of military to civilian advantages remains constant throughout the period. The number of volunteers, however, varies with respect to each of the three exogenous influences; that is, the curve shifts for each influence.

The *first* dummy, $I_1$, represents the Berlin crisis of 1961 when 75,000 reserves were called to active duty, 84,000 enlisted men were kept in service after their terms of enlistment had expired, and draft calls were increased. The Berlin crisis was a rapid buildup that tended to temporarily inflate the eligible pool of potential recruits. The variable assumes the value of 1 during this crisis.

The *second* dummy, $I_2$, considers the period of the Vietnam War. This conflict has tended to decrease the supply of volunteers to the Air Force. This dummy assumes a value of 1 from the initial buildup in the third quarter of 1965 to the end of 1967.

The *third* dummy, $I_3$, represents the period during which a marriage deferment, instituted by President Kennedy, was in effect. This policy, by exempting from the draft essentially all married young men, offered an individual a way of escaping draft pressure and thus render it unnecessary for him to calculate the probability of future military service in his employment plans. Thus dummy has a value of 1 from the third quarter of 1963 to the second quarter of 1965 inclusive.

To analyze these dummies correctly, however, we must consider them with the draft pressure variables. The marriage deferment and the Vietnam War represent situations that tended to deplete the pool of individuals eligible for the draft by giving a direct deferment from military service and by adding impetus to the search for alternative options, respectively. The Berlin situation "captured" many individuals by its suddenness, thus increasing the number of volunteers to the Air Force: there was not sufficient time before being drafted to obtain exemptions from military service.

Since volunteer flows are seasonal and strongly correlated with the school year, we have introduced seasonal adjustment dummies for the quarters of the year. Therefore, $I_4$, $I_5$, and $I_6$ represent the winter, spring, and summer quarters, respectively.

## IV. THE EMPIRICAL RESULTS

The results of estimating the parameters of Eq. (17) are given below:

$$(22) \quad \ln Y_A = \underset{}{4.3216} + \underset{(3.9980)}{2.1857} \ln (V^m/V^c) - \underset{(-1.2765)}{0.0577} \ln D1 + \underset{(4.7543)}{0.2225} \ln D2 + \underset{(0.5063)}{0.2290} \ln U - \underset{(-3.7331)}{3.1761} \ln Q_A + \underset{(0.5743)}{0.0367} I_1 - \underset{(-3.6098)}{0.4144} I_2 - \underset{(-5.4610)}{0.3080} I_3 - \underset{(-0.1813)}{0.0089} I_4 - \underset{(-0.2698)}{0.0153} I_5 + \underset{(5.1082)}{0.1982} I_6$$

$R^2 = 0.8217$
D.W. = 1.94,

where the values in parentheses are the $t$ statistics. The $t$ statistics show that the ratio of net advantages, the second draft pressure variable, the quality variable, the Vietnam dummy, the marriage deferment dummy, and the Summer quarter dummy are significant at the 5 percent level. The first draft pressure variable, the unemployment variable, the Berlin dummy, the Winter quarter dummy, and the Spring quarter dummy are statistically insignificant. The multiple correlation coefficient of 0.82 indicates that the variation in the number of volunteers is explained rather well by the variations in the independent variables of our model. In addition, the Durbin-Watson coefficient of 1.94 indicates an absence of serial correlation.

We may observe the elasticity of volunteers directly from this equation. Hence the elasticity of volunteers with respect to the ratio of net advantages is the coefficient of $\ln (V^m/V^c)$, namely 2.19, and the elasticity of volunteers with respect to the second draft pressure variable is 0.22. Although the net advantages, draft pressure, and unemployment coefficients are the same for the observed, quality-adjusted supply curve and the actual unobserved supply curve of volunteers as deduced in Sec. II, the negative coefficient of the quality variable $Q_A$ indicates that the observed curve lies significantly to the left of the actual curve. This reflects the recruiting process that has been discussed above: fewer men are accepted into the Air Force than actually volunteer, and the ones accepted are the better volunteers. Another way of considering the quality variable is in terms of an *a priori* quality level. If the implicit recruiting standards were lowered to decrease the mean quality level of recruits by 1 percent and all men meeting these reduced standards were accepted, we would observe a 3.18 percent increase in the number of volunteers.*

Although the interpretation of the effect of the draft on the supply of Air Force volunteers is rather elusive, some tentative conclusions can be drawn with the aid of the dummy variables. The highly significant positive coefficient of draft variable D2 implies that some individuals enlist in the Air Force to avoid induction into the Army. At the same time, the Vietnam War has a strong negative effect on the

---

*In a sense the quality of the recruit force is determined jointly with the number of volunteers: for a given demand, quality varies directly with the number of volunteers. At the same time, for a given number of volunteers, the quality of the recruit force varies inversely with the demand for recruits. However, if we consider that recruiters actually attempt to cream the eligible population and by so doing implicitly determine the quality level of recruits, the quality variable becomes the mechanism for equilibrating the demand for recruits with the supply of volunteers. The quality variable transforms the number of recruits into the number of volunteers; and its use as an independent variable eliminates the inherent bias of estimating just a recruit equation.

number of volunteers. This may be interpreted as a distaste for the war in general and as an avoidance of any chance of engaging in conflict. Similarly, when individuals were afforded the opportunity of a marriage deferment, those who would have enlisted in the Air Force to avoid induction accepted the deferment instead, thus reducing the supply of volunteers.

Three other supply curves that are closely related to the above curve were also estimated: 1) the supply curve of volunteers for Categories 1, 2, and 3; 2) the supply curve of volunteers for Categories 1 and 2; and 3) the Category 1 volunteer supply curve. The individual categories were previously defined in Table 1. The supply curve for Categories 1, 2, and 3 was estimated as:

$$
\begin{aligned}
(23)\quad \ln\,(Y_A)_{1-3} = {} & 2.6530 + \underset{(4.0282)}{2.2288} \ln\,(V^m/V^c) - \underset{(-1.2298)}{0.0562} \ln D1 \\
& + \underset{(4.8101)}{0.2280} \ln D2 + \underset{(0.5340)}{0.2445} \ln U - \underset{(-2.5490)}{2.1952} \ln Q_A \\
& + \underset{(0.4946)}{0.0320}\, I_1 - \underset{(-3.7151)}{0.4317}\, I_2 - \underset{(-5.4116)}{0.3090}\, I_3 \\
& - \underset{(0.2797)}{0.0139}\, I_4 - \underset{(-0.2840)}{0.0163}\, I_5 + \underset{(5.1709)}{0.2027}\, I_6;
\end{aligned}
$$

$R^2 = 0.8233$

D.W. = 1.93.

where the values in parentheses are the $t$ statistics.

For this group of volunteers, the change in net advantages is more important; however, the quality adjustment is not as pronounced, as would be expected since there is apt to be less excess supply.

Similarly, the estimated supply curve for Categories 1 and 2 (together) volunteers is

$$
\begin{aligned}
(24)\quad \ell n\,(Y_A)_{1-2} = \; & 1.0817 \quad \underset{(3.9772)}{2.1457\,\ell n\,(V^m/V^c)} - \underset{(-1.6054)}{0.0716\,\ell n\,D1} \\
& + \underset{(4.8636)}{0.2247\,\ell n\,D2} + \underset{(0.5306)}{0.2369\,\ell n\,U} - \underset{(-1.5985)}{1.3423\,\ell n\,Q_A} \\
& + \underset{(0.9286)}{0.0585\,I_1} - \underset{(-3.4316)}{0.3888\,I_2} - \underset{(-5.3519)}{0.2981\,I_3} \\
& - \underset{(-0.1010)}{0.0049\,I_4} - \underset{(-0.4429)}{0.0248\,I_5} - \underset{(5.0809)}{0.1946\,I_6};
\end{aligned}
$$

$R^2 = 0.8350$
D.W. = 1.87.

where the values in parentheses are the $t$ statistics.

For this subgroup, the quality adjustment factor is considerably less important. However, the level of significance implies that the recruiting process is not perfect and that some Category 2 volunteers are not accepted, even though many Category 3 and 4 volunteers become recruits. Such an occurrence could happen because of the geographical quota system and a relative abundance of Category 1 and 2 volunteers in one particular area and their shortage in another.

For the three supply curves described above, the explicit consideration of the quality adjustment mechanism is an important element in inferring the parameters of the true supply relationship. However, the quality variable in the following supply curve for Category 1 volunteers is insignificant. This, of course, was to be expected because of the excess demand for Category 1 personnel that has historically existed and because the supply curve could be observed directly; this supply curve is

$$
\begin{aligned}
(25)\quad \ln (Y_A)_1 = &- \underset{}{0.1089} + \underset{(4.0918)}{2.3641} \ln (V^m/V^c) + \underset{(0.5367)}{0.0256} \ln D1 \\
&+ \underset{(2.4636)}{0.1217} \ln D2 - \underset{(-1.2932)}{0.6175} \ln U - \underset{(-0.1684)}{0.1512} \ln Q_A \\
&+ \underset{(0.4970)}{0.0335} I_1 - \underset{(-3.5371)}{0.4287} I_2 - \underset{(-4.5748)}{0.2722} I_3 \\
&+ \underset{(2.3050)}{0.1194} I_4 + \underset{(1.5309)}{0.0917} I_5 + \underset{(3.5281)}{0.1443} I_6;
\end{aligned}
$$

$R^2 = 0.7988$
D.W. = 1.91.

where again the values in parentheses are the $t$ statistics.

In general, the percentage of explained "variation" in the number of volunteers was rather high for the four regressions, and the Durbin-Watson statistics of approximately 1.9 indicate an absence of any significant serial correlation for the regressions.

For the sake of comparing the importance of the separate arguments of the supply function (17) on the volunteer rate, and also for comparing the changes in the supply functions for the different subgroups, the coefficients of the four regressions are listed in Table 2.

The quality adjustment is especially prominent in Table 2. For each successive, narrower definition of the volunteer rate, the quality adjustment diminishes in size (read left to right for $Q_A$). Moreover, it can be shown that this quality adjustment is significantly different among the groups of volunteers and directly reflects the amount of excess supply in each group--the larger the coefficient, the greater the excess supply.

Table 2

PARTIAL EFFECTS ON SEPARATE VARIABLES ON VOLUNTEER RATE[a]

| Independent Variables | Dependent Variables | | | |
|---|---|---|---|---|
| | $(Y_A)_{all}$ | $(Y_A)_{1-3}$ | $(Y_A)_{1-2}$ | $(Y_A)_1$ |
| $V^m/V^c$ | 2.19 | 2.23 | 2.15 | 2.36 |
| D1 | -0.06 | -0.06 | -0.07 | 0.03 |
| D2 | 0.22 | 0.23 | 0.22 | 0.12 |
| U | 0.23 | 0.24 | 0.24 | -0.62 |
| $Q_A$ | -3.18 | -2.20 | -1.34 | -0.15 |
| $I_1$ | 0.04 | 0.03 | 0.06 | 0.03 |
| $I_2$ | -0.41 | -0.43 | -0.39 | -0.43 |
| $I_3$ | -0.31 | -0.31 | -0.30 | -0.27 |
| $I_4$ | -0.01 | -0.01 | -0.00 | 0.12 |
| $I_5$ | -0.02 | -0.02 | -0.02 | 0.09 |
| $I_6$ | 0.20 | 0.20 | 0.19 | 0.14 |

[a]The numbers corresponding to $V^m/V^c$, D1, D2, U, and $Q_A$ are the elasticities of response of the volunteer rate to these arguments.

## V. SUMMARY AND CONCLUSIONS

This paper has developed a model of military enlistment behavior based on the principle of occupational choice. While not measuring tastes directly, we have observed the enlistment decisions of individual and then related variations in enlistment behavior to variations in the present values of military and civilian earnings, thus theoretically deriving a supply curve of Air Force volunteers. But the attractiveness of the Air Force, both in itself and as an escape from the draft, has resulted in an excess supply of volunteers. Because of this excess supply and the lack of data on the total number of volunteers, direct estimation of this supply curve was precluded. However, in the context of the "queueing" concept of labor markets, we developed an adjusted supply curve from which we could infer the parameters of the actual, but not observable, supply curve of total volunteers. The adjustment consisted of incorporating into the supply formulation variations in the average quality of those who enlisted as a correction for unobserved variations in the excess supply. Further we argued that the average quality of recruits (those volunteers who were actually accepted into the Air Force) varied directly with the excess supply: the greater the excess supply of volunteers, the greater the average quality of recruits.

In describing the results of the statistical estimation of parameters of the supply equation, we presented the parameters of four equations. The four equations differ in that each considers a different range of quality for the volunteers. Each quality range further assumes an excess supply different from the other quality ranges. The results of estimating these four equations highlight at least two very interesting results. First, the magnitude and the importance of the quality adjustment vary significantly across the four supply equations and are directly related to the magnitude of the excess supply. The "shift" in the supply curve due to the excess supply of volunteers and the Air Force's "creaming" process varies from a "quality elasticity" of 3.18 (and statistically significant) for the greatest amount of excess supply, represented by Eq. (22), to a "quality elasticity" of 0.15 (and statistically insignificant) for the least amount of excess supply, in Eq. (25). Secondly, the elasticity of supply with respect to the military-civilian earnings ratio is substantially larger than that obtained in previous studies. The estimated elasticity of approximately 2.19 is larger than the highest previous elasticity of 1.36 that was obtained by Oi [9]. Thus universal military pay increases enacted by Congress will induce a greater percentage of men to volunteer for the Air Force than for the Army. Or what is more appropriate--a universal military pay increase necessary to satisfy the Army's requirements in a "no draft" world will more than suffice for the Air Force.

The method of incorporating a quality adjustment in estimating the supply of volunteers is applicable to virtually all labor markets. Most markets have substantial quality variations among the units supplied and not all applicants receive positions at the established wage. If the employer has some ability to distinguish quality and the demand curve is perfectly inelastic (in the short run) the quality of the accepted applicants will reflect the amount of excess supply. Although there are many examples of such markets, some are: the employment of semi-skilled labor in which (*ceteris paribus*) teenagers are hired only when the adult labor pool has been exhausted; the college selection area in which high school grades and SAT scores provide selection criteria; and the academic market for Ph.Ds where quality can be distinguished using established criteria.

There is one further implication which has extensions to labor markets in which excess supply exists. If the supply curve is estimated without the quality variable, the estimated pay elasticity will be biased downward. The average quality of Air Force recruits depends positively on the ratio of military benefits to civilian benefits. As the ratio increases, more individuals at every quality level volunteer to the Air Force. For a fixed demand and because of the process of taking the "better" volunteers first, the requirements will be satisfied with volunteers of higher quality on average. On the other hand, the number of recruits is negatively related to the average quality of recruits. For a given number of volunteers, as the requirements for volunteers, and hence for recruits, decrease the average quality of recruits increases. Thus a misspecification bias exists and the product of the above two coreelations represents the bias which is negative. Thus directly estimating a supply curve on the observed values for employment by excluding a quality adjustment, when in fact excess supply exists, leads to an underestimate of the true elasticity of supply.

# APPENDIX

The net advantages that determine individual enlistment preferences were defined in Section I as $E = V^m/\hat{V}^c = V^m/(1+z)V^c$, where $V^m$ represents the present value of the income received during the first term of Air Force enlistment, $V^c$ is the present value an individual could receive in the civilian economy, and (1+z) is the compensation factor associated with the enlistment decision.

## Pecuniary Military Benefits

To construct the pecuniary military benefits, $V^m$, of first-term enlistment, we combined expected Congressional pay changes by rank and years of service with observed changes in promotion rates for each point in time. Subsequent discounting at a 20 percent rate of time preference* yielded the perceived value of the pecuniary advantages of a four year Air Force enlistment.

Consider now an individual who contemplates entering the Air Force as an airman in quarter k of year j. Let t = 1, 2, 3, 4 represent his first four years of service, r = 1, 2, 3, 4 the particular quarter in any given year t, and i = 1, ···, 7 the relevant enlistment pay grades. Then we can define**

---

*See first footnote, page 19.

**Changes in airmen distribution by pay grade and years of service from year to year indicate changes in differential promotion rates across grades by years of service. The distributions for each year available are included in Table 3.

Table 3

DISTRIBUTION OF AIRMEN: PAY GRADES AND YEARS OF SERVICE

| Year | Total | E7 | E6 | E5 | E4 | E3 | E2 | E1 |
|---|---|---|---|---|---|---|---|---|
| June 1959 | | | | | | | | |
| 0-1 | 46036 | .0004 | .0007 | .00097 | .0015 | .0324 | .6924 | .2716 |
| 1-2 | 59816 | -- | .0001 | .0004 | .0015 | .3209 | .6563 | .0208 |
| 2-3 | 85964 | .00002 | .0001 | .0009 | .0265 | .7643 | .1909 | .0174 |
| 3-4 | 86413 | .00001 | .0002 | .0051 | .1908 | .7257 | .0683 | .0099 |
| June 1961 | | | | | | | | |
| 0-1 | 90991 | .00002 | .00002 | .0010 | .0002 | .0219 | .7548 | .2220 |
| 1-2 | 79084 | .00005 | .0002 | .0011 | .0028 | .6499 | .3257 | .0203 |
| 2-3 | 55972 | .00002 | .0002 | .0021 | .1207 | .7928 | .0734 | .0108 |
| 3-4 | 46071 | .00007 | 0004 | .0042 | .3147 | .6250 | .0471 | .0085 |
| Oct 1962 | | | | | | | | |
| 0-1 | 119913 | .000008 | .0002 | .0016 | .0011 | .1876 | .6245 | .1850 |
| 1-2 | 93547 | .00001 | .00007 | .0018 | .0500 | .6617 | .2685 | .0180 |
| 2-3 | 77238 | .00005 | .00004 | .0120 | .2768 | .6305 | .0585 | .0143 |
| 3-4 | 41936 | .0009 | .0003 | .0114 | .5532 | .3984 | .0307 | .0060 |
| June 1963 | | | | | | | | |
| 0-1 | 93240 | -- | -- | -- | -- | .1003 | .7381 | .1616 |
| 1-2 | 97147 | -- | -- | -- | .0183 | .6783 | .2905 | .0129 |
| 2-3 | 89299 | -- | -- | .0034 | .2358 | .6717 | .0774 | .0118 |
| 3-4 | 58001 | -- | .00002 | .0079 | .5397 | .4134 | .0324 | .0065 |
| June 1964 | | | | | | | | |
| 0-1 | 87731 | -- | -- | -- | -- | .0955 | .7228 | .1817 |
| 1-2 | 80817 | -- | -- | -- | .0135 | .6653 | .3050 | .0162 |
| 2-3 | 92129 | -- | -- | .0032 | .2146 | .6857 | .0879 | .0087 |
| 3-4 | 70084 | -- | .0002 | .0159 | .4959 | .4437 | .0366 | .0077 |
| June 1965 | | | | | | | | |
| 0-1 | 72715 | -- | -- | -- | .0047 | .0538 | .7084 | .2378 |
| 1-2 | 72825 | -- | -- | .0014 | .0925 | .5403 | .4406 | .0145 |
| 2-3 | 74902 | -- | -- | .0071 | .4393 | .7699 | .1273 | .0116 |
| 3-4 | 78745 | .0002 | .0006 | .0196 | .2838 | .5377 | .0322 | .0055 |
| June 1966 | | | | | | | | |
| 0-1 | 195985 | -- | -- | .0022 | -- | .2718 | .6058 | .1203 |
| 1-2 | 67947 | -- | -- | .0013 | .0912 | .8532 | .0449 | .0095 |
| 2-3 | 73005 | -- | -- | .0016 | .4683 | .4952 | .0288 | .0060 |
| 3-4 | 48381 | -- | -- | .0522 | .6348 | .2884 | .0195 | .0051 |
| June 1967 | | | | | | | | |
| 0-1 | 173276 | -- | -- | .0054 | -- | .3324 | .5837 | .0785 |
| 1-2 | 118628 | -- | -- | .0007 | .2102 | .6488 | .1335 | .0068 |
| 2-3 | 65630 | -- | -- | .0016 | .7316 | .2419 | .0198 | .0052 |
| 3-4 | 43030 | -- | -- | .0343 | .8019 | .1427 | .0166 | .0046 |

$p_{jkitr}$ = the probability of an individual who enters in quarter k of year j being in pay grade i during quarter r of year of service t;

$e_{jkitr}$ = the expected earnings in grade i for quarter r of year t for the individual entering in quarter k of year j.

The individual's expected earnings for quarter r of year t can be computed by summing across all the pay grades:

$$H_{jktr} = \sum_{i=1}^{7} (p_{jkitr})(e_{jkitr}) . \qquad (26)$$

But our data constrain us to consider only the probability of being in grade i during year t; that is,

$\tilde{p}_{jkit}$ = the probability of an individual who enters in quarter k of year j, being in pay grade i during year t.

Similarly, we must consider the expected earnings of each pay grade during each year:

$\tilde{e}_{jkit}$ = the expected earnings for grade i during year t for person who enters in quarter k of year j.

The individual's expected earnings for year t can then be constructed as in Eq. (26). Thus, a youth who enlists in quarter k of year j can expect earnings $\tilde{H}_{jkt}$ for year t:

$$\tilde{H}_{jkt} = \sum_{i=1}^{7} \tilde{p}_{jkit}\tilde{e}_{jkit} . \qquad (27)$$

We observe $\tilde{p}$ directly, but $\tilde{e}$ must be calculated from the observed pay changes over the period and some assumptions about individuals' expectations. There have been a number of changes in base pay since 1959, all of which have occurred in either the third or fourth quarter of the calendar year. Let v represent the quarter and h the year in which the pay change occurs. We assume that the individual considers all future yearly changes in monthly salary to be of the same percentage as the most recent increase. Then, given the actual military pay in quarter k of year j, we can calculate the expected pay for quarter r of year t in pay grade i as

$$(28) \qquad e_{jkitr} = \begin{cases} (1+\alpha_{hvi})^{t-1} I_{jkit}, & \text{for } r = 1, \cdots, \phi \\ (1+\alpha_{hvi})^{t} I_{jkit}, & \text{for } r = \phi + 1, \cdots, 4 , \end{cases}$$

where

$$\phi = \begin{cases} v - k & \text{for } k < v \\ 4 & \text{for } k = v \\ 4 - (k-v) & \text{for } k > v \end{cases}$$

and

$I_{jkit}$ = the quarterly earnings for grade i for t years of service when an individual enlists during quarter k of year j

and

$$\alpha_{hvi} = \frac{\hat{I}_{hvi} - \hat{I}_{h,v-1,i}}{\hat{I}_{h,v-1,i}} \qquad v = 2, 3, \text{ or } 4 ,$$

where $\hat{I}_{hvi}$ are the observed earnings in quarter v of year h for grade i; and $\alpha_{hvi}$ equals the percentage change in earnings for grade i when the change occurs in quarter v of year h.

Then an individual's expected earnings for his $t^{th}$ year of service in grade i, when he enters in quarter k of year j, is given by

(29) $$\tilde{e}_{jkit} = \sum_{r=1}^{4} e_{jkitr} .$$

Hence the expected earnings for year t are

(30) $$\tilde{H}_{jkt} = \sum_{i=1}^{7} \tilde{p}_{jkit}\tilde{e}_{jkit} .$$

We can now calculate the present value of military pay ($V^m$) for a four-year initial enlistment term beginning in quarter k of year j, namely,

(31) $$V^m_{jk} = \sum_{t=1}^{4} \frac{\tilde{H}_{jkt}}{(1+\beta)^t} ,$$

where $\beta$ is the appropriate discount rate for the relevant age specific population of Air Force volunteers; i.e., $\beta = 0.2$ for this analysis.

Pecuniary Civilian Benefits

To construct the pecuniary civilian benefits $V^c$, we have combined the age specific income and the changes therein during the period 1959 to 1967,* with the observed age distribution of airmen enlistees.** Both the changing age distribution of airmen enlistees and the changing

*The U.S. Bureau of the Census publishes male income figures for the age groups 14-19 years and 20-24 years. We included this data in Table 4, together with weekly earnings data for production workers in manufacturing industries.

**This distribution is given in Table 5.

Table 4

ANNUAL ESTIMATES OF AVERAGE WEEKLY EARNINGS OF PRODUCTION AND NON-SUPERVISORY WORKERS IN MANUFACTURING, AND ANNUAL INCOMES OF FULL-TIME MALE WORKERS 14-19 AND 20-24[a]

| Fiscal Year | Avg Weekly Earnings in Manufacturing[b] | Annual Incomes of 14-19 Year Old[c] | Annual Incomes of 20-24 Year Old[c] |
|---|---|---|---|
| 1958 | $ 82.71 | $1833 | $3462 |
| 1959 | 88.26 | 1904 | 3721 |
| 1960 | 89.72 | 1974 | 3916 |
| 1961 | 92.34 | 1938 | 4045 |
| 1962 | 96.56 | 2146 | 4165 |
| 1963 | 99.38 | 2221 | 4229 |
| 1964 | 101.40 | 2364 | 4339 |
| 1965 | 106.71 | 2392 | 4706 |
| 1966 | 110.95 | 2420 | 5041 |
| 1967 | 112.44 | 2716 | 5312 |
| 1968 | 120.18 | 2800 | 5700 |

[a]Figures are for the month of March, each year.

[b]U.S. Bureau of Labor Statistics, *Employment and Earnings and Monthly Report on the Labor Force.*

[c]U.S. Bureau of the Census, *Statistical Abstract of the United States: Current Population Reports,* Series P-60, *Consumer Income.*

Table 5

AIR FORCE ENLISTEES: ACTIVE DUTY NON-PRIOR-SERVICE MALE ACCESSIONS BY AGE, Fiscal Years 1957 to 1968

(In Thousands)

| Fiscal Year | Estimated Median Enlistment Age | Total | Age at End of Fiscal Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 17-17½ | 17½-18½ | 18½-19½ | 19½-20½ | 20½-21½ | 21½-22½ | 22½-23½ | 23½-Over |
| 1957 | 19.0 | 107 | 2 | 22 | 28 | 25 | 14 | 7 | 5 | 4 |
| 1958 | 18.7 | 59 | 4 | 14 | 18 | 11 | 6 | 3 | 2 | 1 |
| 1959 | 18.8 | 62 | 2 | 11 | 23 | 13 | 6 | 3 | 3 | 1 |
| 1960 | 18.6 | 83 | 4 | 19 | 30 | 16 | 7 | 3 | 3 | 1 |
| 1961 | 18.5 | 112 | 3 | 22 | 41 | 23 | 11 | 5 | 4 | 3 |
| 1962 | 18.7 | 107 | 3 | 21 | 40 | 22 | 10 | 5 | 4 | 2 |
| 1963 | 18.7 | 92 | 3 | 18 | 34 | 19 | 9 | 4 | 3 | 2 |
| 1964 | 18.9 | 87 | 2 | 13 | 30 | 21 | 10 | 5 | 4 | 2 |
| 1965 | 18.9 | 82 | 2 | 13 | 29 | 16 | 12 | 6 | 2 | 2 |
| 1966 | 19.7 | 160 | - | 5 | 37 | 64 | 32 | 12 | 5 | 5 |
| 1967 | 19.2 | 107 | - | 5 | 35 | 42 | 13 | 5 | 4 | 3 |
| 1968 | 19.5 | 84 | - | 2 | 23 | 34 | 14 | 5 | 3 | 3 |

distribution of civilian pay by age affect the aggregate expected pay that these enlistees forego in the civilian sector.

Again, let 1959 be in the first year of our time period and let age 17 be the youngest in our age distribution and equal to 1. Then we can define

$p_{ms}$ = the probability that an individual who enlists in year m is s years old; m = 1, ···, 9 and s = 1, ···, 7;

$e_{mst}$ = the expected earnings in the civilian sector foregone in year t of his enlistment by the person s years old entering in year m; t = 1, ···, 4.

The average expected civilian earnings foregone in year t of service by individuals entering the Air Force in year m can be written as

$$G_{mt} = \sum_{s=1}^{7} p_{ms} e_{mst} . \tag{32}$$

This formulation is a weighted average based on the age distribution of Air Force entrants.

Expected annual increases in civilian income from year m to year m + 1 are assumed to be at the same rate as that observed from year m − 1 to year m. Foregone expected income, then, in year t of military service is

$$e_{mst} = (1+\delta_{mn})^{t-1} I_{mn} , \tag{33}$$

and

$$\delta_{mn} = \frac{I_{mn} - I_{m-1,n}}{I_{m-1,n}} ,$$

where $I_{mn}$ is the civilian income of an n-year-old in year m observed by an s-year-old entering the Air Force in year m, and $n = s + t - 1$.

The present value of four years' income in the civilian sector as perceived by the males contemplating enlistment as airmen in year m can be calculated as

$$(34) \qquad V_m^c = \sum_{t=1}^{4} \frac{G_{mt}}{(1+\beta)^t} ,$$

where β is the appropriate discount rate--namely, 20 percent. The quarterly data are linear interpolations of the annual calculations. Thus, the present value of civilian income foregone for an individual enlisting in quarter k of year j is

$$(35) \qquad V_{jt}^c = \sum_{t=1}^{4} \frac{G_{jkt}}{(1+\beta)^t} .$$

The calculation of net advantages E is then the ratio of $V^m$ to $\hat{V}^c$; that is,

$$(36) \qquad E_{jk} = \frac{V_{jk}^m}{\hat{V}_{jk}^c} = \frac{V_{jk}^m}{V_{jk}^c(1+z)} = \frac{1}{(1+z)} \frac{\sum_{t=1}^{4} \frac{\tilde{H}_{jkt}}{(1+\beta)^t}}{\sum_{t=1}^{4} \frac{G_{jkt}}{(1+\beta)^t}} .$$

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