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A RAND NOTE

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**THE SUPPLY OF ENLISTEES TO THE
SELECTED RESERVE FORCES**

William McNaught
with the assistance of Corson Francisco

July 1981

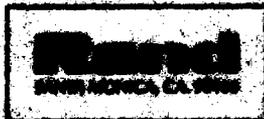
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Prepared For

Office of the Assistant Secretary of
Defense/Manpower, Reserve Affairs
and Logistics

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PREFACE

This Note was prepared under Task Order 79-III-1, Reserve Supply, as part of Rand's Manpower, Mobilization and Readiness Program, sponsored by the Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics)--OASD(MRA&L).

With manpower issues assuming an ever greater importance in defense planning and budgeting, this program seeks to develop broad strategies and specific solutions for dealing with present and future defense manpower problems. The program includes the development of new methodologies for examining broad classes of manpower problems, as well as specific problem-oriented research.

This Note uses a simple model of labor force participation to examine the supply of accessions to the Selected Reserve Forces: The Army National Guard, Army Reserve, Navy Reserve, Marine Corps Reserves, Air National Guard, and Air Force Reserve. The study constitutes one part of a larger effort by Rand to examine various aspects of the reserve forces. It should prove of interest to analysts and planners concerned with reserve manpower policies.

A rectangular filing stamp with a grid. The top row contains the letters "DTIC". The bottom row contains a large handwritten letter "A". There are other faint markings and lines in the stamp, including a checkmark in the upper right corner.

SUMMARY

Manning levels in the Selected Reserve Forces declined for 5 successive years after the end of the draft. Most of this decline occurred in the Army Selected Reserve Components: the Army Reserve and Army National Guard. During the draft, the manning of these components was highly dependent on enlistees choosing reserve service rather than being drafted into the active forces. The strategy for replacing these draft-motivated reserve enlistees during the all-volunteer era was to raise reserve wage levels and benefits, increase recruiting and advertising effort and increase retention. However, the effect of these programs on enlistments was highly uncertain. One hypothesis for the reserve strength decline was that the effect of these programs, particularly pay increases, was overestimated and that additional pay increases would be required to stabilize strength at levels attained during the draft. A measurement of the effect of increasing reserve pay on enlistments could determine the magnitude of a pay raise required to attain various strength levels.

This Note examines the supply of accessions to the Selected Reserve Forces. The decision to join the Reserves involves both a commitment to a second or moonlighting job and a military organization. A model for this decision is developed which combines previous research in secondary civilian labor market participation and military enlistment behavior. This model is tested by using cross-sectional data on reserve enlistment rates and state economic characteristics.

Our results are generally consistent with the predictions of the Reserve participation model. Reserve enlistments increase with increases in military pay and unemployment, and decrease with increases in pay received on the primary job, pay received from secondary jobs, and hours worked on the primary job. Unfortunately, the results of the analysis are too weak to obtain definitive results for policymaking. In particular, we are unable to rule out the possibility of either a completely inelastic reserve supply function (in which pay has no effect on accession rates) or a reserve supply function with a unitary

elasticity (in which percentage changes in pay are offset by equal percentage changes in accessions).]

However, these results provide clear signals for future reserve research. Future reserve models should be disaggregated below the state level, and are probably best conducted at the level of individual reserve units. Individual units can differ widely in their manpower demand characteristics and their supply curves, which are determined by local labor market characteristics. Using the individual Reserve unit as the unit of observation can improve the estimates presented here, although the data collection necessary to model behavior at the unit level is much more extensive than undertaken for this model.

Developing an improved measure of Reserve recruiting effort is also critical to improving the model. This measure may be difficult to develop since Reserve recruiting is accomplished through both formal and informal channels. One interpretation of the results would point to an important role for informal recruiting channels. In the informal recruiting network, participating reservists obtain new enlistees from their own circle of friends and acquaintances. But this effort tends to depend on unit management priorities and internal unit incentives. The formal recruiting effort varies by component. For some components, recruiting is handled by commands which have responsibility for both active and reserve recruiting. For others, recruiting is done by separate organizations devoted only to Reserve recruiting.

Finally, a more complex model of Reserve supply seems appropriate. In particular, the model must consider both supply and demand considerations, reflect interactions between components, and account for non-pecuniary factors.

ACKNOWLEDGMENTS

We would like to thank our Rand colleagues William Butz, Frank Camm, David Grissmer, and James Hosek for their assistance in the preparation of this Note. We are grateful to Colonel Jack Lilley and Lieutenant Colonel Donald McCabe of OSD(MRA&L) for their help in obtaining reserve data and information about reserve force policies and procedures. Catherine Boyd assisted us with many of our computer runs and data analyses.

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I. INTRODUCTION

Reserve manning and readiness levels are important issues in the ongoing debate about the viability of the all-volunteer force. The reserve forces contain a substantial proportion of the nation's total defense capability, as Fig. 1 shows. By nearly any measure, the reserves comprise the majority of U.S. tactical combat capability. They even have a vital role in strategic conflict, as attested by the figures for strategic tanker aircraft and defense interceptors.

The combat capabilities of the reserves will vary in importance according to the nature of the conflict being fought. In a low-intensity conflict, active force units that are structured for quick response would probably be used exclusively. Even moderate-intensity conflicts, such as that in Vietnam, have been fought over extended periods without calling on the reserves. Reserve unit participation would again be unlikely if the conflicts required only a few specialized capabilities that are already disproportionately contained in the active force. An example of a conflict of this second type would be an amphibious operation. If the nation wishes, however, to prepare for contingencies demanding heavy use of ground forces, defense planners cannot ignore the major role the reserves would then play.

Many observers harbored grave doubts about the readiness of these units during the initial years of the all-volunteer force. The official defense readiness evaluation system, FORSTAT, reported in 1977 that the average selected reserve unit was only "marginally ready."¹ At the end of 1976, Army reserve units faced large shortages in vital equipment: tanks (63 percent), howitzers (81 percent), and personnel carriers (60 percent).²

¹Congressional Budget Office, Improving the Readiness of the Army Reserve and National Guard: A Framework for Debate, February 1978.

²Military Posture and H.R. 5068: Department of Defense Authorization for Appropriations for Fiscal Year 1978, Hearings, Part 5, p. 561.

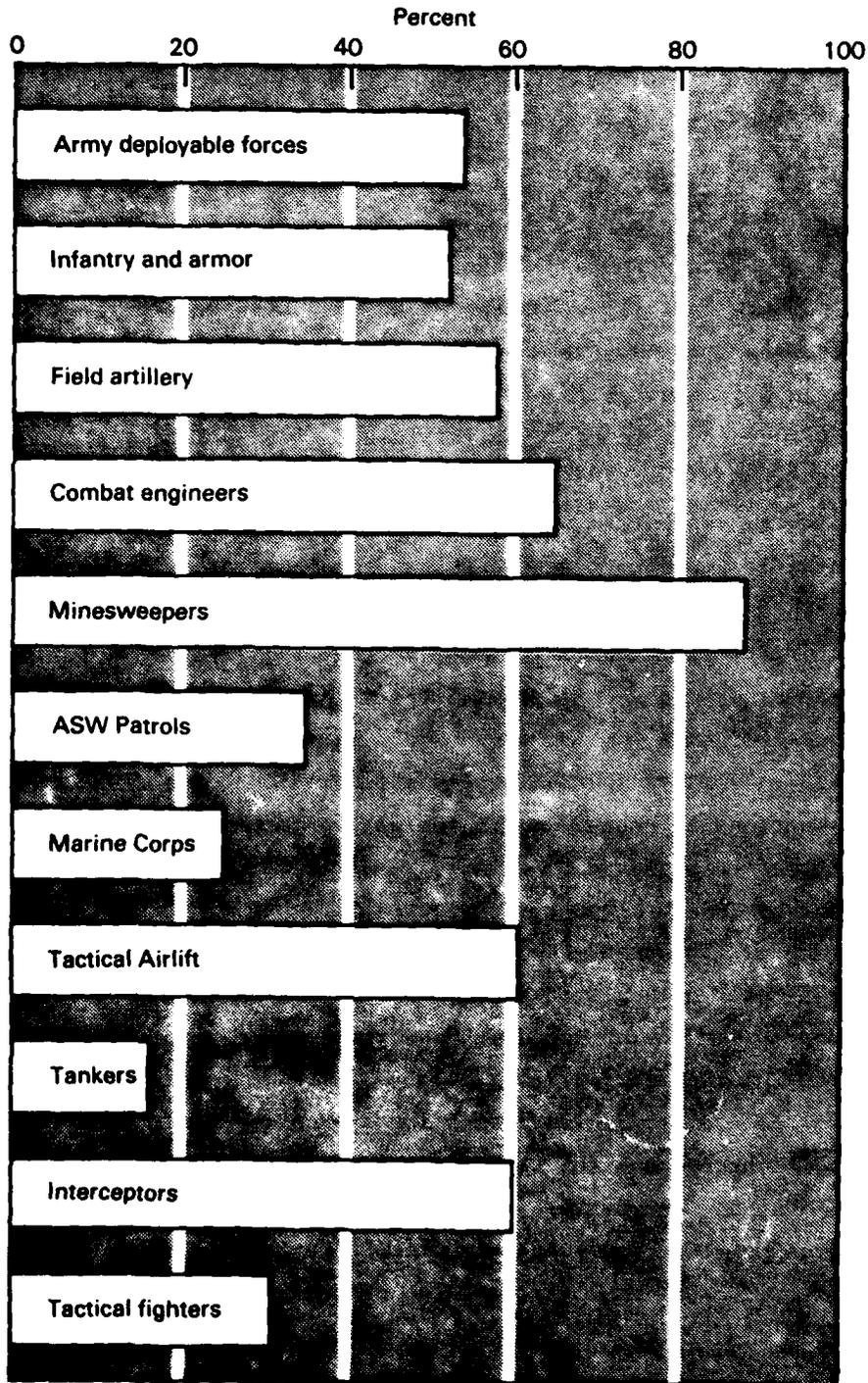


Fig. 1—The selected reserve forces as part of the total force (from *Military Posture and H.R. 5068: Department of Defense Authorization for Appropriations for Fiscal Year 1978, Hearings, Part 5, p.553*)

Personnel shortages were also common. Assigned strength in all components of the selected reserve had decreased 12.2 percent from 1973 to 1978 (Fig. 2). These declines were concentrated in the two Army Reserve Components. Although assigned strengths in 1979 were only 3.0 percent below their authorized levels, Table 1 shows that these authorized levels have also been falling. Since there have been no corresponding decreases in reserve mission requirements, customary comparisons of present strength with current authorized positions understates real reserve manpower deficiencies. Comparisons of 1979 strengths with 1975 authorization levels reveal much more serious shortages.

Achieving full unit manning is certainly one of the barriers to higher levels of readiness. Although Selected Reserve Strength has increased in both FY79 and FY80, it still has not returned to the level of the early 1970's. Perhaps, more importantly, there is still considerable uncertainty in the effect which pay increases, bonus payments, or additional recruiting would have on strength levels. More precise measurements of these effects are necessary to design efficient and effective programs to boost strength.

Table 1
MANPOWER STRENGTHS AND AUTHORIZATIONS OF THE SELECTED
RESERVE FORCES AS OF JUNE 30, 1979

Force	1979			1975	
	1979 Strength	Authori- zation	Percent Shortage ^a	Authori- zation	Percent Shortage ^b
Army National Guard	344455	362000	4.8	400000	13.9
Army Reserve	187985	196000	4.1	225000	16.5
Navy Reserve	86232	87000	0.8	117000	26.3
Marine Corps Reserves	32051	33000	+2.9	37000	13.4
Air National Guard	92728	92000	-0.8	95000	2.4
Air Force Reserve	54468	53000	-2.8	51000	-6.9
DoD	797919	823000	3.0	925000	13.7

^a1979 strength vs. 1979 authorization.

^b1979 strength vs. 1975 authorization.

Source: Office of the Deputy Assistant Secretary of Defense (Reserve Affairs), "Reserve Forces Manpower Charts," June 30, 1979.

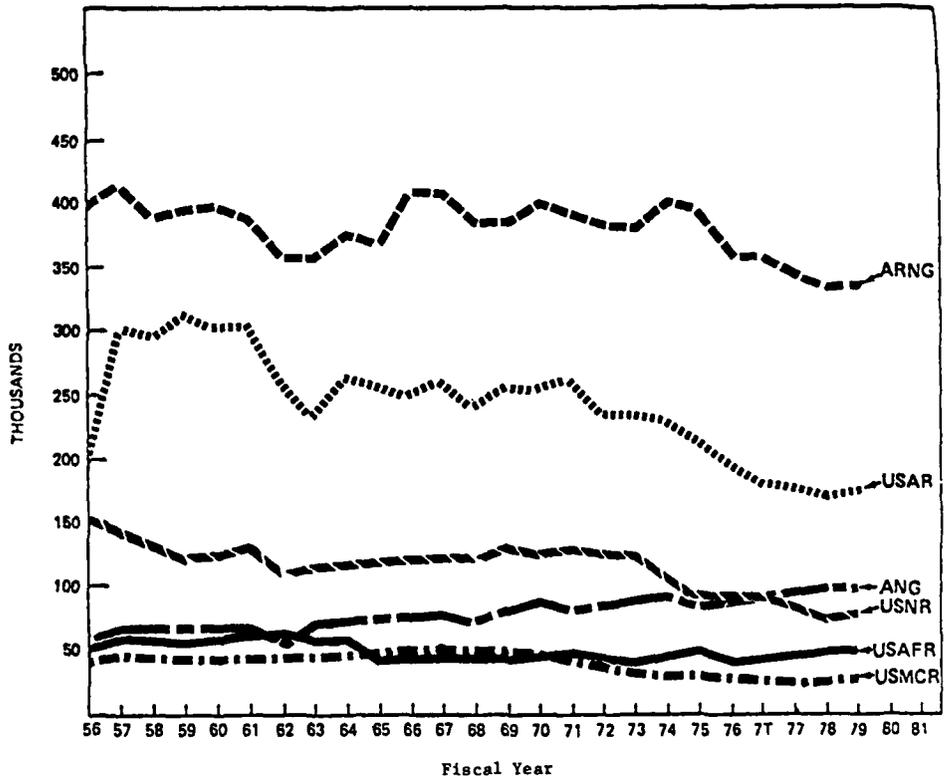


Fig. 2--Strength trends in the selected reserve components

This Note discusses the behavior of enlisted personnel serving in the selected reserves. The bulk of our analysis addresses only the initial decision to enlist in a Selected Reserve Component. Although the Individual Ready Reserve (IRR)³ is experiencing manpower shortages even more severe than those of the selected components, few members enter the IRR voluntarily; consequently, few data are available for studying the possible motivations toward IRR participation.⁴

This Note investigates the characteristics of reservist supply. (We use the term "supply" in its classic economic sense: the quantity of personnel volunteering their services to the Selected Reserve Forces at any given wage level.) The conclusions herein are intended to contribute directly to the reserve planning process. Knowledge of the reserve supply function, especially the associated wage elasticity,⁵ should assist reserve manpower planners in choosing among various investments to improve reserve readiness. Besides changes in compensation, some alternative investments for increasing reserve manning are: shorter tours, education subsidies, changes in drill frequency, increased recruiting expenditures, split enlistment programs in which enlistees spend time in both the active and reserve forces, and split training programs covering two consecutive summers. A full analysis should compare all these policy options before determining optimal reserve force management policies.

Moreover, the attainment of mandated end strengths is merely a necessary condition, hardly a sufficient condition, for achieving desired reserve readiness goals. Even with the programmed number of people, reserve planners must still procure personnel with the right mix of skills and experience. In June 1978, a commission studying the reserve compensation system concluded that:

³The Individual Ready Reserve consists mainly of veterans who have completed active military service, but are not continuing military training by participating in drills as individuals or as unit members. They are still liable for recall to active duty in the event of national emergency.

⁴Recently, bonus payments have been offered to reenlisting members of the IRR. These payments would allow exploring IRR motivation.

⁵A wage elasticity shows the percentage change in reserve enlistments that results from a 1 percent change in wage rates.

Not only is there a general shortage of personnel to meet either the authorized or required manning levels, there are significant deficiencies in many critical skill areas as well as severe mismatches that are not yet fully identified.⁵

The commission's report went on to describe large shortages in junior enlisted personnel in each of the six selected reserve components.

This Note uses a simple theory of secondary labor-force participation to analyze the reserve enlistment decision. This theory, developed in Sec. II, emphasizes the tradeoff of leisure time for increased income as a key element in the reservist's supply decision. It also includes factors that distinguish the reserve enlistment decision from all other decisions to take a second job.

Section III below discusses the many difficult problems encountered in assembling the data necessary to test this model. Both the available reserve personnel data and the data about secondary labor markets require a number of adjustments before they are suitable for use in our empirical analysis.

Section IV presents the results, which generally confirm the hypotheses derived from our simple model. Our results about wage elasticity, however--the key policy parameter--remain uncertain.

Finally, Sec. V comments on the policy implications of these results. Although the wage elasticity results are not definitive, they call into question DoD's heavy reliance upon increased compensation incentives for solving reserve manning problems. This section also suggests further research studies that could increase our knowledge about reserve supply behavior.

⁵ Reserve Compensation System Study, Final Report, Office of the Deputy Assistant Secretary of Defense (Reserve Affairs), June 30, 1978, p. III-52.

II. THEORETICAL MODEL

A clear statement of a theoretical model facilitates the analysis of any complex phenomenon. This is especially true in those cases where the meanings of many data elements are ambiguous. Although questions of reserve participation, in particular, and secondary and part-time labor force participation, in general, have received comparatively little examination in the past, we are fortunate that an economic model of this behavior is a relatively straightforward extension of customary models of labor supply. In order not to belabor the derivation of the economic relation which underlies our analysis, this section will borrow freely from the study by Robert Shishko and Bernard Rostker, which developed the first rigorous theory of moonlighting behavior.¹

Although an economic model of moonlighting behavior can illuminate many important facets of the reservist's participation decisions, the model ignores many other important dimensions of the decision. Prospective reservists also consider travel costs, the effect of restricted reserve working hours, and social factors such as friendships with other reservists. This section will alter the simple moonlighting model to include some of these dimensions. Other dimensions must be left as important but as yet unintegrated elements.

A MODEL OF THE MOONLIGHTING DECISION

We can analyze the reserve participation decision as a special case of the decision to take a second job, or moonlight. If workers were free to set their own hours, every worker would set his or her length of work according to his or her own marginal valuation of time-- that is, desire for material goods and services available through wage

¹Robert Shishko and Bernard Rostker, "The Economics of Multiple Job Holding," American Economic Review, June 1976, adapted from Rostker and Shishko, Air Reserve Personnel Study, Vol. II: The Air Reserve Forces and the Economics of Secondary Labor Market Participation, The Rand Corporation, R-1254-PR, August 1973.

payments as opposed to the dislike of work and the desire to enjoy additional free time. Because fixed working hours are the rule in most parts of the economy, many workers must overwork or underwork. The secondary job market offers those who desire additional income through increased working hours an opportunity to tailor more closely their work schedule to their desires.

Figure 3 shows how this process works. On the horizontal axis is the worker's scarce resource, time, which may be devoted to work or leisure. The vertical axis is income derived from work. The wage rate in the primary job is w_0 and the fixed working hours are $B - L_0$ (work hours are read from B to the left). At this point, the worker is not satisfied, because the slope of the indifference curve U, denoted w'_0 here and equal to the marginal valuation of time, lies below the wage rate w_0 . If the secondary labor market offers a wage equalling the primary wage, then the worker will contract for additional hours of work. In this case, the worker completes $L_0 - L^*$ additional moonlighting hours.

Using a more rigorous approach and some weak assumptions,² Shishko and Rostker show that the change in secondary hours worked may be either directly or inversely related to changes in the secondary wage, is inversely related to changes in the primary wage, and is inversely related to primary work hours. Also, changes in non-labor income are inversely related to hours worked in the secondary job market.

In their article, Shishko and Rostker estimate a supply curve for moonlighters using data from the Income Dynamics Panel of the University of Michigan and the Tobit regression technique. In addition to the economic variables mentioned above, they include demographic variables for the age of the moonlighter, family size, and annual housing cost in their equation. The signs of the effects listed above are confirmed by their analysis. They also find that the supply of moonlighting labor is positively related to moonlighting

² Specifically, they must assume leisure is a superior good and that the primary wage exceeds the moonlighting wage. See the Shishko and Rostker article for the full proof.

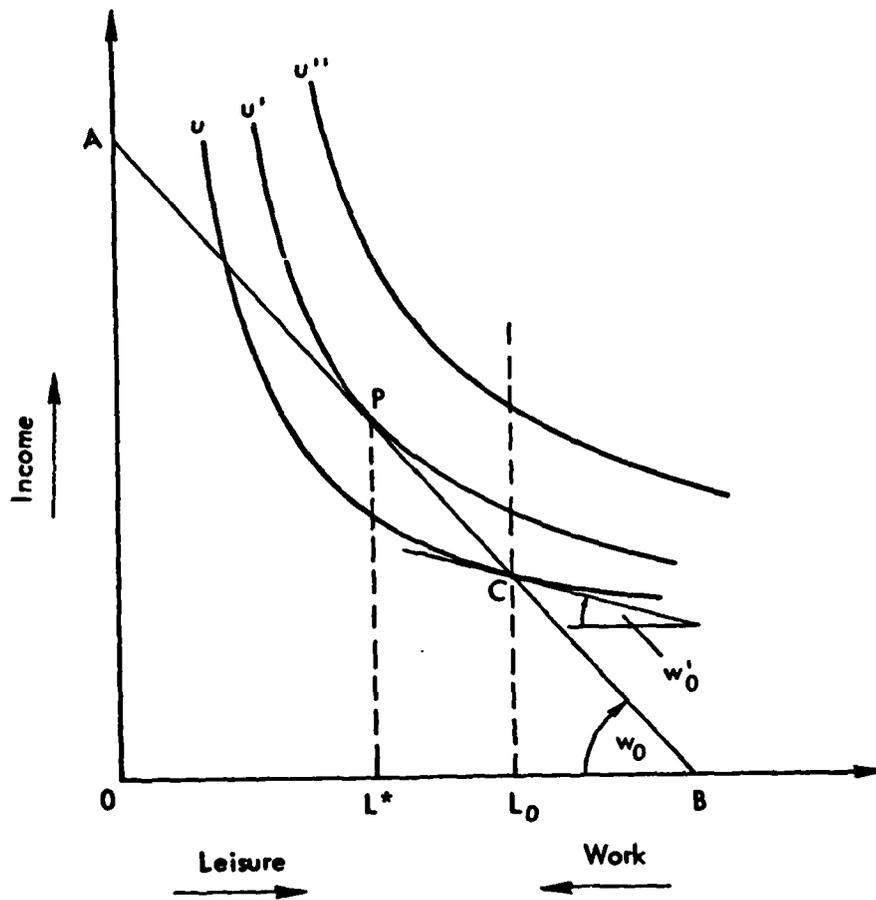


Fig. 3 -- Effect of restricting hours worked on primary job

wages. The pay elasticities of secondary labor supply are estimated to be 1.10 for secondary wages and -0.86 for primary wages. The elasticity of secondary labor supply with respect to primary work hours is the largest of any in the equation, -1.35.

Previous comparisons of moonlighters and workers declining to moonlight had shown that many of these same variables were important.³ In contrast to workers with only one job, moonlighters have the following characteristics relatively to single-job workers:

Age	Younger
Education	More
Families	Larger
Income (primary)	Smaller
Income (non-labor)	Smaller
Housing Expense	Greater
Hours (primary)	Less

Thus economic theory suggests a relation like Equation (1) for the analysis of moonlighting propensities. There we use C and S to represent primary and secondary wage rates respectively, H for primary hours worked, and X for the various other variables used to proxy for the household's tastes for additional goods and services. Q is the quantity of moonlighting services provided.

$$Q = f(C, S, H, X) \quad (1)$$

In addition, we can reasonably expect that the supply function will display the following partial derivatives:

$$\frac{\partial Q}{\partial C} < 0 \quad \frac{\partial Q}{\partial S} > 0 \quad \frac{\partial Q}{\partial H} < 0$$

³See, for example, Vera C. Perella, "Moonlighters: Their Motivation and Characteristics," Monthly Labor Review, August 1970; Harvey R. Hamel, "Moonlighting: An Economic Phenomenon," Monthly Labor Review, October 1967; Harold W. Guthrie, "Teacher in the Moonlight," Monthly Labor Review, February 1969.

APPLYING THE MOONLIGHTING MODEL TO RESERVE PARTICIPATION

The analysis of reserve supply has several additional features beyond those associated with moonlighting activity. Most of these features stem from the fact that reservists are members of the military.

We can divide selected reserve enlistees into two categories. The first category includes all personnel who have completed no previous military training. The second category includes those individuals who have completed a prior term of military service. Our analysis shall in all cases distinguish the first category of non-prior (NPS) enlistees from the second category of prior service (PS) enlistees.

The distinction is important theoretically because NPS enlistees must complete initial training while on full-time active duty in the military before they can join a reserve unit. Thus the NPS enlistment decision has many of the characteristics of a decision to enlist in the active military. In fact, many NPS reserve enlistees are disguised active duty enlistees who use reserve entrance procedures to sample military life or to circumvent active force enlistment screens. Therefore our model of the enlistment decisions of NPS personnel must consider motivations associated with active force enlistment.

The topic of active military manpower supply has been extensively investigated over the past decade. A reader interested in this literature should consult Alan Fechter's survey article.⁴ Fechter characterizes these prior studies as generally agreeing on an enlistment function with the following determinants:

$$A = f(M, C, U, D, P, I, X) \quad (2)$$

where A is active force supply
M is the military wage
C is the civilian wage
U is the unemployment rate
D is draft pressure
P is the population of eligible enlistees

⁴Alan E. Fechter, "Review of the Literature: Some Methodological Issues," Chap. 2 in Dorothy M. Amey et al., Econometric Models of Armed Forces Enlistment Levels, General Research Corporation, Bethesda, Maryland, October 1976.

I is the stock of available information about military jobs
 X includes a variety of other variables

The vector X usually contains variables such as special enlistment programs, seasonal dummies, or regional dummies.

Combining the lessons of the theory of secondary labor supply and the theory of military manpower supply suggests the basic functional relationship that will determine reserve participation. Principal independent variables are primary and secondary wage rates as well as reserve pay itself. In this case, the prospective recruit chooses between reserve service and civilian moonlighting, so that reserve pay and the secondary wage measure the return to the competing secondary labor market opportunities. The primary wage acts as an income proxy which affects the propensity to enter the secondary labor market. Other variables are similar to those cited by Fechter.⁵ Thus, the basic equation is:

$$R = f(W, C, S, H, U, P, I, X) \quad (3)$$

where R is reserve participation,
 W is the reserve wage,
 and other variables are as defined above.

Rostker, in a companion piece to his study with Shishko, estimated a relation similar to Eq. (3) for the Air Force Reserve.⁶ Unfortunately, the lack of information on some important variables and the confounding influences of draft pressure on much of the data complicated this analysis. Rostker did include variables for both primary and reserve wages, population, age of enlistees, and regional effects. His estimates indicate that the wage elasticity of supply for Air Force NPS enlistees is about 1.3. This would imply that wage increases are a relatively efficient method for solving reserve supply

⁵ Ibid.

⁶ Bernard Rostker, Air Reserve Personnel Study, Vol. III: Total Force Planning, Personnel Costs, and the Supply of New Reservists, The Rand Corporation, R-1430-PR, October 1974.

problems. The elasticity of reserve supply with respect to primary wages was estimated to be -2.5 in the absence of draft pressure.

Robert Kelly has also estimated two forms of the reserve supply function for NPS and PS personnel.⁷ He measures reserve supply as the sum of accessions to each of the six components. He uses cross-sectional methods similar to those used in Sec. IV of this Note. His independent variables include reserve pay relative to primary civilian wages, unemployment, and population. His results are very different from Rostker's. He estimates the wage elasticity as .10 for NPS reservists and .35 for PS reservists.

The only other study which examines the reserve supply function is a related study of my own.⁸ In that study I fit a model similar to Eq. (3) with time-series data. I concluded that while unemployment had an important impact on NPS reserve enlistments, data problems prevented any reliable determination of the wage elasticity from time series data.

Thus the prior three examinations of reserve supply behavior have arrived at very different conclusions. In part this stems from differences in the underlying data. Specifically, results seem quite sensitive to the use of time-series or cross-sectional methods. The choice between the two sampling methodologies therefore needs a little more explanation.

If data were freely available, time-series methods would certainly be preferable to cross-sectional ones. Time-series models are better suited to the incorporation of dynamic phenomena so important to reserve manpower policy. They can include changes in the national economy which can influence individual decisions to participate in the reserves. More important, they can follow different cohorts of youth and veterans to examine changes in their behavior over time. Cross-sectional analysis

⁷ Robert Kelly, "The Supply of Volunteers to the Selected Reserve," Department of Social Sciences, United States Military Academy, May 1979 (mimeo).

⁸ William McNaught, Projecting Future Accessions to the Selected Reserve Components, N-1563-MRAL, The Rand Corporation, August 1980.

instead leaves us unable to project behavioral conclusions about present cohorts into assessments of future cohort behavior. Because management by cohort is a key principle of reserve personnel policy, compensation decisions depend upon dynamic models.

One example of data limitations for time series analysis is the near absence of any data whatsoever on the number of prior service accessions prior to 1975. Another problem is the absence of variation between reserve and civilian pay. Since 1948, the levels of reserve compensation have been tied to active force pay tables. Active force pay was in turn tied to civilian pay levels by the Federal Pay Comparability Act of 1970. Although the pay caps of the late 1970s have broken this linkage to a small extent, reserve and civilian pay have risen roughly at the same rate since 1971. Without variations in reserve compensation rates relative to civilian opportunities, we cannot reliably estimate a wage elasticity of reserve supply. Until such variations in relative pay occur, perhaps through the newly instituted reserve bonus programs, analysts will have to rely upon cross-sectional analyses.

This is not to say that cross-sectional studies are not useful in their own right. If states are used as the observation unit, as is customary in military manpower studies, we can observe state-to-state differences in recruiting performances while important economic differences are held constant. Thus, we can predict how well a state should be doing based on average performance across the nation and compare this to the state's actual recruiting performance. Alternatively, the model could be used to estimate state bonuses necessary to fill units located in shortage areas or to identify states with potential for filling additional units at relatively low rates of pay.

In summary, then, we find there is little consensus among analysts about the exact nature of the reserve supply function. Cross-sectional estimates of the wage elasticity differ markedly from time-series estimates. Decisionmakers should exercise extreme caution before using the cross-sectional estimates described in this Note to make dynamic policy decisions.

COMPLICATING FACTORS

Before we proceed to the statistical sections of the Note, we should remind the reader about a few complications to this simple model. Reserve participation is more than just another part-time job. The working conditions of the reserve forces differ in important respects from the civilian economy. Reservists must obligate for tours of duty up to six years and accept military discipline. They can be called to full-time duty during mobilization or civil emergencies.

The scheduling of drills is inflexible. Nearly all members of the selected reserve drill in units. Because a successful military operation depends on teamwork, effective reserve training requires the scheduling of joint training exercises. In civilian part-time jobs, employers often realize the difficulty of scheduling additional work and grant the worker some control over the job assignment schedule.

The simple model of Fig. 4 shows how important this rigidity can be. Inflexible secondary hours can prevent a prospective secondary labor-force participant from even entering the market. Even though the secondary wage, w_o , exceeds the value of time, w_o' , if the additional secondary hours are fixed above a level $L_o - L$, then the worker is better off foregoing any secondary work whatsoever.

Figure 4 also shows a situation in which the rigid secondary hours $L_o - R$ are less than desired hours ($L_o - L^*$). Some utility gains are still available to the moonlighter. This case, in which secondary hours are fixed at a level less than the moonlighter would otherwise choose, is probably more typical of the situation faced by most reservists.⁹ In this case, however, utility gains will be less than those possible in the unconstrained case of flexible secondary hours.

Participation in reserves also depends upon travel costs. Large travel costs can easily offset any utility gains associated with

⁹ Most reservists attend 16 hours of reserve drills per month. The typical civilian moonlighter works 13 hours per week on the second job.

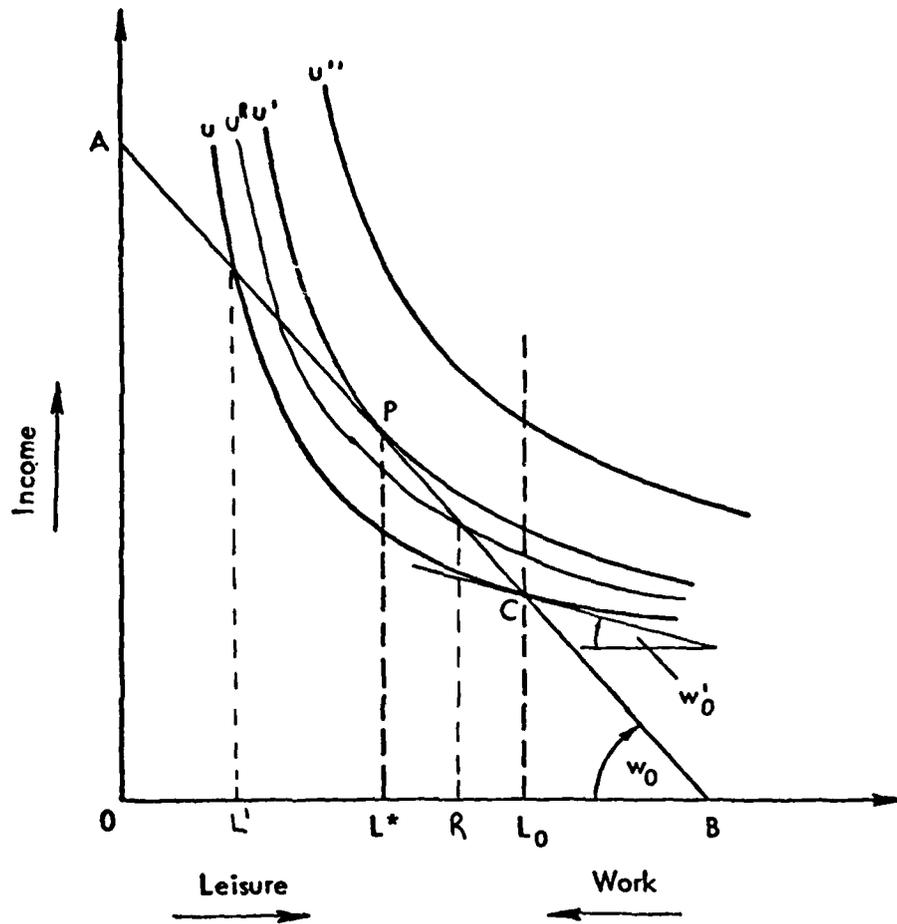


Fig. 4 -- Effect of restricting hours worked on the second job

reserve service, as Fig. 5 shows. Even small travel costs, when combined with the decreased utility gains caused by restrictions in reserve working hours, can result in nonparticipation by individuals who would gladly have served if additional hours of reserve work had been available and if the reserve training site had been located closer to their homes.

Another negative factor is the probability of call-up. Although no significant number of reserve units have been called to active duty since the Berlin crisis, the possibility is always there. This would result in the possible loss of the full-time job, or at least the loss of seniority increases over the period of call-up. For members of the National Guard, call-ups to serve the state in times of natural disaster are reasonably frequent. This can mean unpredictable periods of time away from family or job.

There is also a positive side to reserve working conditions. Well-run reserve units offer the soldier a sense of accomplishment, esprit de corps, and social service. Although call-ups in state emergencies can prove inconvenient, they offer the soldier an opportunity to provide social service to the community. In fact, we could have constructed a model of reservist behavior which allotted these social factors, community service and esprit de corps, the central focus. In such an approach, sociological theory and survey techniques would replace economic models and econometric equations. Lowndes Stephens¹⁰ has employed just this type of organizational model to explain reservist behavior. Stephens argues that monetary incentives alone are insufficient for retaining reserve personnel. Using survey techniques, he finds effective reserve leadership and community service opportunities to be equally important determinants of reservist behavior.

¹⁰Lowndes F. Stephens, "Recruiting and Retaining the Citizen-Soldier," Armed Forces and Society, November 1977.

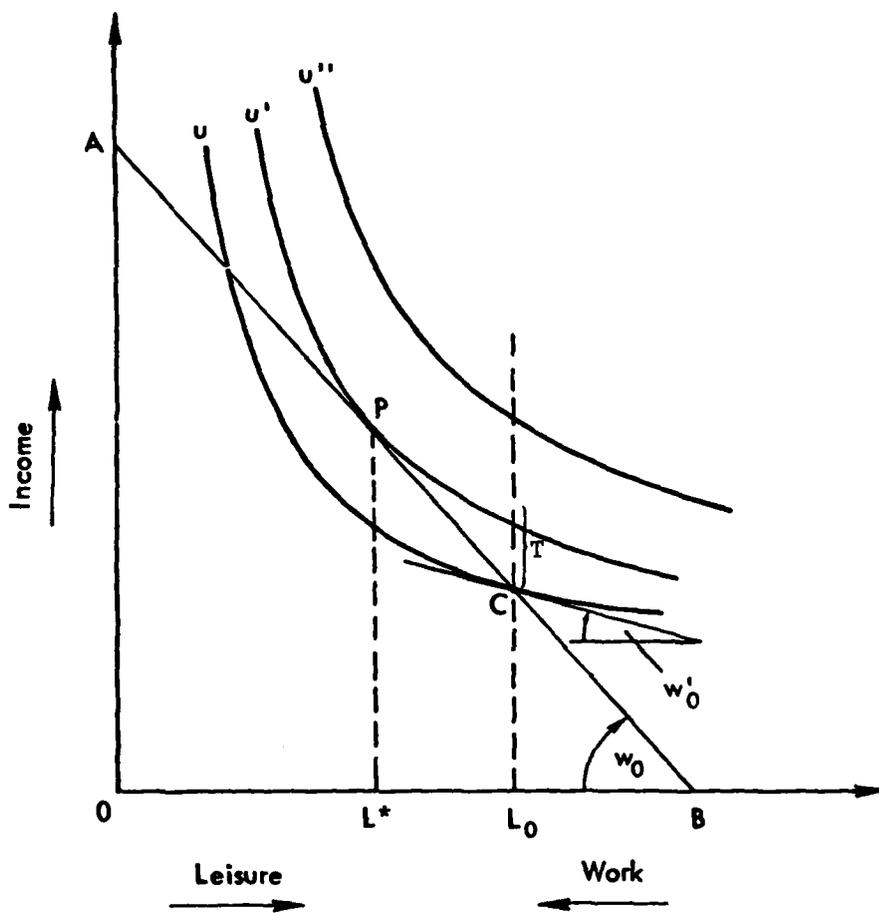


Fig. 5--Effect of travel cost

Other special factors in the reserve job apply specifically to either NPS or PS personnel. NPS recruits do not enlist purely for a secondary job. The recruit must first undergo basic military training and, in most cases, special training in the assigned Military Occupational Speciality (MOS) before entry into the reserve unit. During this training period, the recruit is indistinguishable from active duty recruits. Many part-time-job seekers cannot find enough time to attend such training, which lasts a minimum of 12 weeks or 2 periods of 8 week split training. Others are unwilling to incur the dislocation only to qualify for a part-time job at its completion. On the other hand, in some skills in substantial demand in the civilian sector, the training opportunity can be the most important reason for enlisting.

Thus in the NPS case, the enlistment decision is not purely one of secondary labor-force participation. In the models that follow, we will ignore the interrelationships between secondary and primary participation decisions. A more complete model would certainly include opportunities for active force enlistment as an important competing alternative to reserve enlistment for NPS personnel.

For prior service personnel, a major enlistment incentive is the benefit package which accompanies reserve service. Some of the extensive benefits available to active military personnel are also available to reservists--PX privileges and low-cost life insurance, for example. The monetary value of these is dwarfed by the reserve retirement system. This system is quite complex and we will not describe its full detail here.¹¹ Basically, the reservist qualifies for a pension at age 60 if he or she has completed twenty good years of service. A good year is credited for any year of active service or for any year in which the reservist accomplishes the rough equivalent of attending a two-week annual training period and 48 drill periods.

¹¹A complete description of the system can be found in the Reserve Forces Almanac, Lee E. Sharff (publ.), Uniformed Services Almanac, Inc., Washington, D.C., 1977, p. 23-25.

THE FINAL MODEL

In this section we have sketched a simple theory of reservist behavior. The model highlights the trade of leisure time for additional income as the central motivation for reserve participation. We have discussed some prior studies which applied this model to sets of reserve data, both time-series and cross-section. Finally, we have discussed some complications to the theory. We have found that the theory directly subsumes some of these complications while others must be left as mere caveats to the results to come.

When we combine all the elements discussed in this section, we obtain a model like the following:

$$R = f(W, C, S, H, U, P, I, T, X) , \quad (4)$$

where R is reserve participation,

W is the reserve wage,

C is the civilian primary wage,

S is the civilian secondary wage,

H is hours worked on the primary job,

U is the unemployment rate,

P is the population of eligible enlistees,

I is available information about reserve enlistment opportunities,

T is travel cost, and

X is a set of regional dummies.

III. DESCRIPTION OF DATA

This section describes the data used to estimate the model set forth in Sec. II. Besides noting the major data sources, we will carefully document the steps we have followed to transform the original raw data into a form suitable for model estimation. In the case of the reserve accessions data, these steps involved careful computer processing of DoD tape files. In the case of the three principal pay variables, these steps involved important judgments about data accuracy and proper functional representation. We will keep our discussion of other variables as brief as possible.

RESERVE ACCESSION DATA

The primary data source for reserve personnel information is the Reserve Components Common Personnel Data System (RCCPDS), maintained in the Reserve Affairs Directorate of OSD(MRA&L). This system originated in March 1973. It became the official source for inventory figures for the reserve forces in July 1974. In July 1976 it became the official source for all personnel transactions--principally gains and losses--as well. There is no doubt that this system has been beset with growing pains during its short life. Its reliability was quite low at its inception, but has steadily increased over time.

RCCPDS depends on the reserve components for its inputs. It does little to improve the quality of the personnel data it receives. Rather, it mainly reformats these data into a single common format. Because it relies on the components, and because all components do not operate an integrated inventory and transactions accounting system, the RCCPDS does not necessarily match inventory changes to gains and losses. That is, a reservist registered by the transactions system as an enlistee may not appear on subsequent inventory files. Because inventory and end-strength figures are much more important to personnel planners and Congressional overseers, and because of severe constraints on the amount of resources that can be expended on improving the system, the accuracy of the gain and loss data may not be high.

Kelly's work, reviewed in Sec. II, used the comparison of successive inventory files to estimate reserve accessions. We have instead chosen to rely upon the reported accession figures themselves. Neither course is entirely satisfactory. Often, reservists appearing for the first time upon an inventory file have initial reserve entry dates substantially earlier than the dates of their appearance. This time lag could seriously bias accessions analysis. On the other hand, reserve attrition rates are quite high. We do not know how many of the reported accessions might not be serious reserve enlistees.

The RCCPDS publishes monthly reports of reserve accessions by state. These published figures are too aggregated for our use because they differentiate only between NPS and PS personnel. Consequently, we obtained a tape of all individual accessions during 1977 as recorded by RCCPDS. We summed the individual data into a five-way classification of 1977 accessions for each component. We categorized accessions by state, mental category, sex, education, and type--prior service or non-prior service. Since we recognized four mental categories and two education levels--high school graduate or non-high school graduate, we obtained an accessions matrix with 1632 different cells of accessions levels.

In the analysis presented in Sec. IV, we use only a subset of these data. In the NPS case, we define reserve supply as all enlistments by Category I through III male high school graduates. The omitted categories of (1) females, (2) Category IV personnel, and (3) non-high school graduates account for 68.5 percent of all NPS accessions to the selected reserves. In the PS case, we use all enlistments, male and female, regardless of mental category or educational attainment. These definitions agree with those conventionally employed in active force analysis and those used by other reserve analysts.

Our NPS analysis does not estimate separate enlistment functions for the categories omitted from our reserve supply definition, because data on civilian opportunities were unavailable at this level of detail. Although we could have estimated additional supply relations with the discarded data and the aggregate civilian data we describe below, such a course was beyond the capabilities of this relatively limited effort.

Prior work had led us to believe that RCCPDS misrecorded the prior military training of many of the accessions. During our runs, we checked the length of service and grade of each entrant to determine if either conflicted with the variable describing the individual's prior military service.¹ We found surprisingly few inconsistent classifications.

RESERVE ENLISTMENTS AND THE RELEVANT POPULATION GROUPS

Because we examined the enlistment behavior of non-prior service personnel separately from that of the prior service personnel, we collected two different population figures. For the NPS analysis we defined the eligible enlistment pool as the population of 18-to-24-year-old males.² For PS analysis, we used the total veteran population.³ We used these estimates of the pools of potential enlistees to convert the absolute accession figures obtained from DoD records to enlistment rates by state. Table 2 summarizes these data. NPS accession rates are defined for high school graduate Category I through III NPS enlistments only. We omit the Naval Reserve from the NPS analysis because it accessed only 4 NPS sailors during 1977.

If we classify each state into one of four groups according to its accession rate, a United States map illustrates the geographic dispersion in reserve supply. Figures 6 and 7 show the pattern of total reserve accessions across the states for non-prior service and prior service reservists, respectively.

Table 2 shows the pattern of enlistment behavior across the six reserve components. In 1977 the average state enlisted 1.81 NPS reservists (Category I through III high school graduates) per thousand eligible males. Nearly two-thirds of these NPS enlistees entered the National Guard. Of the 51 states, Hawaii had the largest overall accession rate: 4.21 NPS reservists per thousand eligible males.

¹Of all NPS records, 6.2 percent had either a grade of E4 and above or more than 12 months of service. Only 0.9 percent of the PS records had less than 12 months of service.

²Current Population Survey, Series P-20, No. 334, Table 1, January 1979.

³Figures provided by the Defense Manpower Data Center.

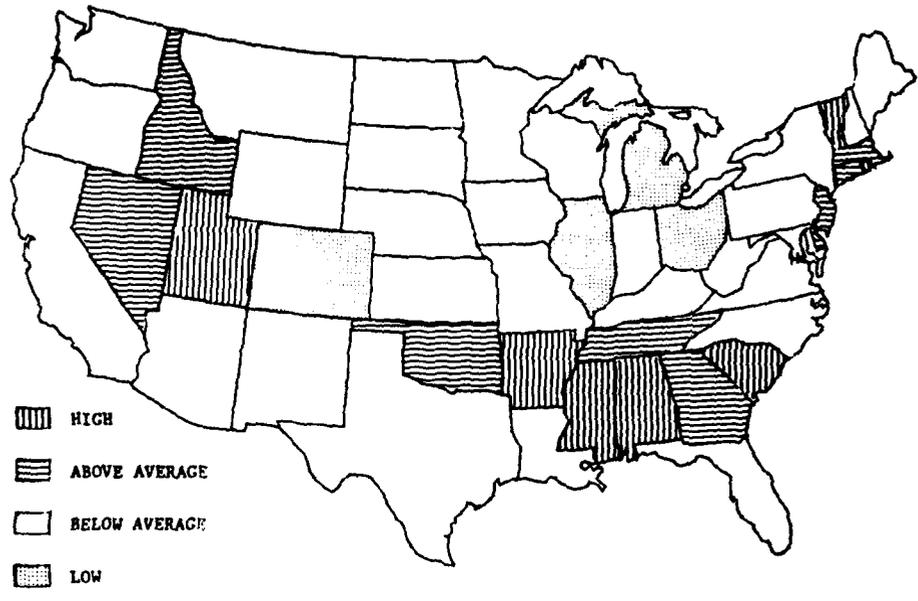


Fig. 7--Variations in PS enlistment rates:
National Guard, 1977

Vermont had the lowest rate of NPS reserve accessions--enlisting NPS personnel at a rate only 10 percent as high as Hawaii's.

Table 2
HIGH AND LOW ENLISTMENT RATES BY STATES, 1977
(Per thousand eligible males)

Component	Average Rate	Standard Deviation	Rate and State	
			Low	High
<i>Non-prior Service</i>				
ARNG	1.181	0.618	0.307 (IL)	2.875 (ND)
USAR	0.246	0.189	0.011 (SD)	1.015 (HI)
USMCR	0.110	0.098	0.002 (CT)	0.396 (DC)
ANG	0.214	0.186	0.027 (NC)	1.030 (HI)
USAFR	0.047	0.047	0.002 (CO)	0.195 (DE)
DoD	1.813	0.804	0.441 (VT)	4.215 (HI)
<i>Prior Service</i>				
ARNG	0.125	0.055	0.043 (IL)	0.268 (MI)
USAR	0.068	0.030	0.009 (SD)	0.183 (DC)
USNR	0.017	0.005	0.006 (AK)	0.026 (MD)
USMCR	0.009	0.009	0.000 (—)	0.063 (DC)
ANG	0.024	0.012	0.003 (FL)	0.069 (AK)
USAFR	0.010	0.009	0.000 (AK)	0.046 (DE)
DoD	0.254	0.085	0.151 (IL)	0.562 (DC)

NOTE: See text for definition of enlistment rates. In three instances, several states recorded no accessions of either NPS or PS reservists during 1977.

The picture for prior service enlistments was not much different. In this case, the District of Columbia had the highest accession rate. Other states with high PS accession rates were, in order: Mississippi, Rhode Island, Alabama, and South Carolina. Illinois had the lowest PS accession rate, but the rates for Colorado, Michigan, and Ohio were also very low.

In general, the enlistment rate distributions are skewed toward high rates of enlistment. States which have high enlistment rates

within one component do not necessarily show high enlistment rates for other components. In the National Guard, smaller states enlist personnel at a much higher rate than larger states.

SOCIOECONOMIC DATA

As noted in Sec. II, estimation of a reserve supply equation must include civilian employment conditions reflected in such variables as primary hours worked, price levels, and unemployment rates. The figures for primary hours worked and unemployment rates that we use in Sec. IV are annual averages for the year 1977 derived from Bureau of Labor Statistics (BLS) data appearing in its monthly publication Employment and Earnings. They represent all nonsupervisory nonagricultural workers in private industry.

We also expect that differences in the purchasing power of incomes across the country will be important. In order to adjust for cost of living differences across states, we developed price-level estimates for each state based on data appearing in BLS News, "Fall 1977 Urban Family Budgets."⁴ This document contains BLS estimates of annual budgets of three hypothetical families--a low, an intermediate, and a high-budget family--in selected urban areas. Our price estimates are weighted averages of the intermediate budget levels in all Standard Metropolitan Statistical Areas (SMSAs) in the state. For states that are essentially nonurban and therefore are not included in the BLS tables, we substituted the relative prices of the region's nonmetropolitan area.

⁴Our use of standard budgets to construct interarea price indexes is not strictly correct. The BLS does not use standard market baskets in all urban areas to weight their indexes. Thus comparison of these market baskets across areas involves the comparison of unlike living standards--in economic terminology, an index number problem. Fortunately, the BLS has analyzed the bias introduced by the varying market baskets. See Mark Sherwood, "Family Budgets and Geographic Differences in Price Levels," Monthly Labor Review, April 1975. Although biases are particularly great for the food and transportation components of the budgets, their individual effects offset each other so that the standard budgets constructed from varying or identical market baskets are relatively similar across areas. We have compared the price indexes which would result from applying our methodology to the 1973 pure price indexes published by the BLS and found their simple correlation to be .95.

We used the 1976 Survey of Income and Education (SIE) conducted by the Bureau of the Census as the source of the income variables in the model.⁵ The SIE was expressly designed to collect accurate income information. The SIE not only instituted an improved system for the processing of survey returns but also geared the interviewers' intensive training and close supervision toward collecting as accurate income data as possible. The interviews were conducted personally, and were scheduled after the general April 15 deadline for filing tax returns. These are considered major factors that led to a reporting of income data that are more accurate and complete than equivalent data from other sources, such as the Current Population Survey of 1976 (CPS) and the 1970 Census.

The theoretical variables for civilian opportunity costs discussed in Sec. II differ in important aspects from the empirical income measures which we construct below. Ideally, we would (1) use wage, not income, measures; and (2) differentiate between primary and secondary, not full-time and part-time jobs. Wage is the more proper concept because it represents payment per unit of time. We have used only income reported by year-round workers to minimize any biases introduced from workers who worked only part of the year. Although the part-time labor market includes many workers who hold a single job, its wage is probably closely related to wages in pure secondary jobs.

The use of part-time income measures may introduce a selectivity bias into the analysis. Theoretically, the variables we desire should measure the wage-offers available to all persons in the labor force. Because persons who do not choose to work part-time have implicitly rejected part-time wage-offers, their exclusion from the sample of part-time workers means that our measure of part-time wage-offers is biased upward. This selectivity problem exists in nearly every study that includes earned wages or incomes as a measure of opportunities. It is more severe in cases, like ours, in which only a small fraction of the

⁵The SIE money income estimates were published in a series: U.S. Bureau of the Census, Current Population Reports--Consumer Income, "Money Income and Poverty Status in 1975 of Families and Persons in the United States by Divisions and States," Series P-60, Nos. 110-113, 1978.

population accepts the wage offer. The range of the fraction of the labor force working part-time in our sample is not so wide that selectivity bias is likely to be a major data problem. It varies from 4.5 percent in Alaska to 12.0 percent in Hawaii.

Male NPS enlistees in the selected reserve incur a six-year service obligation. Our income values must reflect the enlistee's total financial gain and total civilian income forgone throughout these six years of reserve service. The economic concept of the present value of an income stream provides the appropriate measure for this purpose. To convert single-year income estimates to income streams, we calculated the annual growth rate in civilian per capita income by state for the period 1975-1977.⁶ The discount rate was assumed to be 20 percent per year.⁷ The following formulas were used to estimate present values:

$$V_F = \sum_{t=1}^h \frac{C(1+r)^t}{(1+d)^t} \quad (5)$$

$$V_S = \sum_{t=1}^h \frac{S(1+r)^t}{(1+d)^t} \quad (6)$$

where V_F = 1977 present value of mean income of full-time male workers;

V_S = 1977 present value of mean income of part-time male workers;

C = real mean income of full-time male workers in 1977 (adjusted from 1975 levels);

S = real mean income of part-time male workers in 1977 (adjusted from 1975 levels);

⁶ This procedure ignores any movement along the age-earnings profile during the six years and instead captures only shifts of the entire profile. This omission is regrettable, but no data exist on age-earnings profiles by state more current than the 1970 Census.

⁷ There is some empirical support for the existence of high discount rates among military recruits. See Gorman C. Smith and Kenneth M. Bromberg, Subjective Discount Rates and Perceptions of Supplemental

- r = annual growth rate in civilian income;
 d = subjective discount rate of enlistees; and
 h = length of the enlistment term (fixed at six years).

In constructing our measure of annual reserve pay, we assumed that reservists attended all scheduled drills, 48 in number, per year.⁸ We also assumed they attended a 15-day annual training period. We estimated their annual reserve earnings to be \$864. Our military pay variable (M) represents this \$864 deflated by our estimates of the state price level.

To transform our estimate of annual reserve pay to a present value over the NPS enlistment term, we assumed the annual growth rate in military pay to be 7.05 percent. This is the actual size of the pay raise received by all military personnel in October 1977. Non-prior service reservists spend an average of six months at the outset of their career undergoing full-time military training. While training, they receive full military pay and benefits, but of course forfeit any civilian pay that they might have earned. The formulas above were modified to reflect this additional complexity:

$$V_M = \frac{T - \frac{1}{2}(C+M)}{(1+d)} + \sum_{t=2}^h \frac{M(1+m)^t}{(1+d)^t} \quad (7)$$

- where V_M = 1977 present value of a reserve enlistment ;
 T = pay received during initial active duty for training ;
 M = real income of reservists in 1977; and
 m = annual growth rate in military pay.

Benefits of Military Personnel, Information Concepts Incorporated, January 1972. Also, sensitivity tests of discount rates between 5 and 30 percent showed only negligible impacts on the pay coefficients.

⁸Although all reservists receive the same rate of compensation, the number of drill periods attended could vary across states. The Rand survey of reenlistees administered in conjunction with the 1978 Reenlistment Bonus Experiment asked each NPS reservist eligible for his or her first reenlistment how many drills they were paid for in the preceding year. The mean response was 46.0 drills for reservists in Category A units. There was surprisingly little variation by state. The minimum of the average responses was 44.9 in Georgia.

In the analysis of PS enlistments, we have ignored those present value calculations. Most PS enlistments are for a single year only. We use annual real income levels, C, S, and M, instead.

IV. ESTIMATES OF THE RESERVE SUPPLY FUNCTION

This section describes the results obtained when we combine the data described in Sec. III with the model summarized by Eq. (4). In general, the results confirm our hypotheses about reserve behavior. Reservists do behave in an economically rational manner; that is, increases in reserve pay do induce increased reserve participation-- but not by much. The other variables in our model generally influence reservist behavior in ways consistent with our hypotheses. Increases in civilian pay either in the primary or secondary job reduce reserve enlistments, increased unemployment increases enlistments, and increases in hours worked on the primary job decrease enlistments.

We must exercise caution in interpreting any market transaction, in this case a number of reserve enlistments, as a pure supply phenomenon. Variations in observed enlistments could just as easily represent variations in the number of enlistees desired by the reserves. In this paper we will assume that the reserve components prefer prior service personnel of all types and non-prior service personnel who are high school graduates and of mental Categories I through III. For convenience we will label the last category "high quality" enlistees. The latter class will constitute the less preferred enlistment group.

If perfect information were available, then, the enlistment of any low-quality NPS personnel would indicate that the component had accessed all the available supply of the preferred categories of personnel. This being a world of imperfect information, however, components may access some lower quality NPS personnel instead of waiting for personnel in the preferred classes, but changes in the mix of accessions among classes will still indicate relative supply shifts. Thus demand constraints are more likely to be binding in those components that access fewer low-quality NPS personnel.

Table 3 shows the accession mixes of the six components during 1977. The percentage of lower-quality NPS personnel in the two air components and the Navy Reserve is quite small. In these three components demand constraints could have been binding in at least some

Table 3

ACCESSIONS MIXES FOR THE RESERVE COMPONENTS, 1977

Component	Percent High Quality NPS	Percent Low Quality NPS	Percent PS
Army Guard	13.0%	27.6%	59.4%
Army Reserve	6.6%	8.8%	84.8%
Navy Reserve	0.3%	0.0%	99.7%
Marine Reserve	17.2%	30.6%	52.2%
Air Guard	15.6%	2.6%	81.9%
Air Force Reserve	10.2%	2.7%	87.1%
DoD Total	10.9%	18.7%	70.4%

states of the sample. Since our measure of reserve supply in this section will be total accessions to all six components, demand constraints might be a problem if these components accounted for much of this total DoD-wide supply. However, the three components experiencing the most severe shortages also account for the overwhelming majority of reserve accessions: 83.3 percent of all accessions enter the Army components and the Marine Reserve. For NPS accessions, the fraction is even higher--94.1 percent.

This section will first examine the supply functions of NPS reservists. Next it fits an identical supply function to PS data. Finally, it will discuss difficulties in reserve supply analysis and speculate about the nature of individual component supplies.

NON-PRIOR SERVICE RESULTS--DoD TOTALS

Our initial examination of NPS supply will consider the total number of male high-quality NPS enlistments to all the selected reserve components. A DoD-wide supply of recruits is an appropriate measure of reserve supply for two reasons. First, observed reserve accessions are themselves random variables. As random variables, the number of reported accessions may vary from one period to another, even if there are no changes in the underlying determinants of reserve supply. To the extent that each component's accessions are independent of those in other components, summing accessions across all components reduces

the uncertainty in the dependent variable and increases the precision of the estimated coefficients.

Second, accessions into one reserve component are partly dependent upon recruiting activity undertaken by other components. No reserve component ever recruits the full number of potential accessions available to it in all regions of the country or at all points in time. Rather, components marshal their limited recruiting resources and expend them at points of maximum advantage. Thus some components recruit heavily from one region and not another or undertake recruiting campaigns during certain periods of the year. The summation of all reserve accessions into a total accession variable then provides a more accurate depiction of actual reserve supply potential at any single point in time or space.¹

We limit our analysis of NPS supply to high quality male NPS accessions. This group accounts for about 32 percent of all NPS accessions and affords us the best measure of actual NPS supply because the other segments of the NPS supply are more likely to be demand-constrained in some states. To the extent that the decisions of other types of reservists might differ from those of high-quality males, these results do not apply.

Equation 4 in Section II sets out the variables which form the basis for the empirical results presented in this section. Section III discussed the ways we have chosen to measure all but two of these variables. We were unable to obtain data which measured either travel costs or available information about reserve enlistment opportunities. Instead, we resort to the use of proxy variables for these two variables.

Lacking data on commuting costs by state, we have substituted a measure of the state's urban density, the proportion of the population living in rural areas.² We expect that the average distance traveled

¹ A superior approach would examine each component's enlistment supply function individually, but in so doing account for the spillover effects on each component of all other reserve component and active force recruiting activity. We do not attempt such an analysis here because of the difficulty in achieving so complex a model without first understanding the rudiments of reservist behavior.

² U.S. Bureau of the Census, Statistical Abstract of the United States, 1978.

to reserve drills is greater in rural areas and that these higher travel costs would adversely affect reserve supply if other factors are held constant. Our use of the proxy, percent rural, for travel costs presents two problems. First, travel costs are not a simple linear function of urban density. Congestion impedes travel in large urban areas and increases commuting costs. Also conventional wisdom suggests that tastes for military service are greater in rural areas. This shift in relative preferences between urban and rural residents could offset the effects of higher travel costs.

We also lacked any useful data on reserve recruiting efforts by state. Recruiting efforts increase the stock of information about reserve opportunities available to potential recruits. To surmount this deficiency, we hypothesize that reserve recruiting is principally accomplished through an informal network of friendships within the community rather than through any formal network of official recruiters. States with higher percentages of participating reservists therefore have greater amounts of recruiting resources. We measure recruiting activity with the percent of the state's population who were participating reservists at the beginning of 1977.

We have chosen to specify our supply function as a logistic function.³ This function has the useful property that projected reserve enlistment propensities are constrained between zero and unity. We include dummies for eight of the nine census regions. We omit New England--it is implicitly present within the constant term. Thus we hypothesize that:

$$\frac{\sum R_i}{P} = \frac{1}{1 + e^{-\sum B_j Z_j}} \quad \text{Eq. (8)}$$

where R_i is the number of high-quality male NPS accessions to component i and Z_j includes all dependent variables mentioned in Eq. (4).⁴

³We estimate this function using the minimum logit chi-square procedure.

⁴There are errors in the accessions figures reported by the Air Force Reserve during 1977. The Air Force Reserve subsequently corrected

Table 4 displays the results of two alternative specifications of the reserve supply function. Results of the first specification generally confirm the hypotheses of the economic model developed in Sec. II. However, the signs of the variable for primary pay and travel costs (percent rural) disagree with our hypotheses. Neither result is significant.

In our time series analysis,⁵ unemployment proved to be a highly significant factor in the NPS enlistment decision. Here the effect of unemployment is not statistically significant. The probable error present in measuring the employment prospects of young males eligible for NPS enlistment with an overall employment rate could account for the lower significance of these results.

None of the regional dummies is significant. The largest regional dummy belongs to the South Atlantic region. The dummy for the East South Central region, which encompasses Alabama and Mississippi, presumably the bedrock states of the reserve system, ranks fifth within the set. This could indicate that the strengths of the reserve components in these states derive from factors already included in our model.

NPS reservist supply seems particularly sensitive to two variables. Primary hours has a high elasticity, -2.11, but its coefficient is not significant at even the 10 percent level. This result does suggest that primary hours worked may have more influence than pay on reserve participation. In the NPS case, primary hours may have an additional effect on reserve participation beyond the one discussed in Sec. II. Primary hours worked, as measured by the Bureau of Labor Statistics, falls as the ratio of part-time to full-time workers increases. Potential NPS recruits who hold part-time jobs can presumably more readily obtain extended leaves of absence to attend initial basic training. Thus economies with high concentrations of part-time workers may provide

their figures to increase their total reported accessions by 33.2 percent. No corrections by state are available. We have adjusted all Air Force NPS values upward by this same 33.2 percent. Since the errors were concentrated in only a few months of 1977 and probably did vary greatly across states, this correction should be innocuous. Less than 4 percent of NPS accessions to the selected reserves enter the Air Force Reserve.

⁵William McNaught, Projecting Future Accessions to the Selected Reserve Components, The Rand Corporation, N-1563-MRAL, August 1980.

Table 4
ESTIMATES OF THE DoD-WIDE NPS RESERVIST SUPPLY FUNCTION

Variable	Coeff.	t-value	Elast.	Coeff.	t-value	Elast.
Military pay ^a	7.7844	0.29	0.15	-1.3866	-0.42	-0.26
Primary pay ^a	0.0430	0.81	0.43	-0.0210	-0.35	-0.23
Secondary pay ^a	-0.0932	-1.04	-0.38	-1.3113	-1.18	-0.55
Unemployment	0.0286	0.48	0.19	0.0729	0.98	0.49
Primary hours	-0.0524	-0.73	-2.11	-0.1326	-1.51	-5.33
Percent reservists ^b	0.2760	4.73	1.13	--	--	--
Percent rural	0.8367	1.46	0.56	-0.4975	-0.79	-0.33
Regional dummies						
Mid Atlantic	-0.1132	-0.49	--	-0.3440	-1.19	--
East North Central	0.2509	0.98	--	0.0883	0.27	--
West North Central	0.2544	0.87	--	0.2756	0.74	--
South Atlantic	0.3302	1.44	--	0.3384	1.17	--
East South Central	0.0442	0.15	--	0.1211	0.32	--
West South Central	0.1800	0.66	--	0.3286	0.95	--
Mountain	-0.0423	-0.14	--	0.2126	0.57	--
Pacific	-0.0980	-0.39	--	-0.0659	-0.21	--
Constant	-6.4744	-2.11	--	-0.3511	-0.10	--
R ²		.606			.354	
F(15,35)		3.60			1.41	
Number of observations		51			51	

^aPresent value of pay measured in hundreds of thousands of dollars.

^bParticipating reservists per thousand persons.

more fertile recruiting territory for the reserve forces than ones dominated by full-time workers.

Our variable for recruiting effort (the percentage of the state's population serving in the reserves) also exhibits a large elasticity. Its coefficient is highly significant. This could be an extremely important finding, but it must be interpreted judiciously. Although reserve commanders often tout the informal recruiting network as their most effective procurement source, our ability to measure its size with this crude variable is limited. In particular, the population of the state is highly correlated with the population of the eligible recruits, which forms the denominator of our dependent variable. Thus the observed results in Table 4 could possibly stem from spurious correlations, not systematic recruiting effects. Also, cross-year correlations between accession levels are high. High strength levels in 1977 could represent the cumulative effects of variables which we have omitted from our specification but which have induced high accessions levels in prior years.

Because of these potential problems, we present a second equation that excludes the reserve recruiting variable. Although this second specification cannot enlighten us about the recruiting effects themselves, it offers some evidence that its inclusion has not severely biased our measurement of the effects of pay upon reserve supply. Although the signs of the military and primary pay variables are reversed in the new specification, the elasticities continue to be low in absolute value and are insignificant in both cases.

Determination of the true value of these pay elasticities is a prime objective of this study. It is useful to identify three possible ranges for these pay elasticities. First of all, the true pay elasticities could be zero, that is, reservists do not respond to monetary incentives at all. Although many reservists would argue that motivations such as patriotism are far more important than pay to reserve behavior, few would go so far as to claim that pay is irrelevant to all reserve behavior. The t statistics in Table 4 therefore derive from the assumption that pay is indeed an influential variable.

A second possibility is that reserve supply is inelastic, that is, pay elasticities are less than one. Kelly's estimates of the reserve pay elasticity fall into this range.⁶ In their survey of a wide array of civilian labor supply studies, DaVanzo, DeTray, and Greenberg found most elasticities to fall within this inelastic range.⁷

A third possibility is that reservist supply is elastic and reserve pay elasticities are greater than one. Rostker's study of Air Force Reserve enlistments estimated a pay elasticity of 1.3.⁸

Our results are most consistent with the second possibility. However, the low levels of significance associated with these results do not allow us to distinguish between the first and second possibilities. If we recompute our t statistics on the basis of an assumption of a unitary reserve pay elasticity, we obtain values of 1.70 and 2.02 for the first and second specifications, respectively. This allows us to reject the third possibility at the 10 percent level of significance.

However, measurement errors in our pay variables could have biased our estimates and have led to erroneous conclusions in this test of the third possibility. Although our civilian data are generally comparable to those used by Rostker, his use of time-series information afforded him a more accurate depiction of military pay changes than is possible by imputing military pay changes from cost-of-living differentials. To the extent that our military pay measurements contain random error, our estimated coefficients are biased toward zero, and thus the t-statistics for the null hypothesis of a unitary elasticity would be biased upward.

Obviously, these results on their own cannot provide any definitive answer as to the exact value of the reservist pay elasticity. We summarize the evidence about this important parameter in the following section.

⁶Robert Kelly, "The Supply of Volunteers to the Selected Reserve," Department of Social Sciences, U.S. Military Academy, May 1979 (mimeo).

⁷Julie DaVanzo, Dennis DeTray, and David Greenberg, Estimating Labor Supply Response: A Sensitivity Analysis, The Rand Corporation, R-1372-OEO, December 1973.

⁸Bernard Rostker, Air Reserve Personnel Study, Vol. III: Total Force Planning, Personnel Costs, and the Supply of New Reservists, The Rand Corporation, R-1430-PR, October 1974.

PRIOR SERVICE RESULTS--DoD TOTALS

In this subsection we repeat our estimation of the reserve supply equation and replace NPS accessions with PS values.⁹ Our prior-service supply measure includes all accessions regardless of sex or mental category. The PS supply equation remains the same as Eq. (8) as to variables included. We now use annual, not present, values for all three pay variables because prior-service personnel typically enlist only for one-year terms. Our population measure, used to transform total accessions to accession rates, is the number of veterans residing in the state.

Our PS results are very similar to the NPS results, as Table 5 shows. In our first specification, which includes a recruiting variable (percent of population participating in the reserves), coefficients are generally of the correct sign and most of them evidence higher t-ratios than found in the NPS specification.

Of foremost interest is the effect of pay on PS enlistments. The estimated elasticities are nearly identical for military pay and secondary pay and only moderately different for primary pay: .11 for PS as opposed to .43 for NPS. The estimated coefficient for secondary pay is significant at the 10 percent level. On the whole, the results duplicate those of the NPS analysis.

We also present a second specification which excludes the recruiting variable. The pay elasticity estimates are not sensitive to the change in specification. All six of the estimated elasticities fall in the inelastic range, but the precision of the estimates is not high enough to permit confident statements about the exact values of the PS pay elasticities.

Unemployment has the anticipated positive sign. Its elasticity is quite comparable to the one estimated in prior time-series work,¹⁰ .24 here in comparison with .22. We would expect closer agreement in the PS than in the NPS analysis because the general unemployment rate

⁹Like the NPS figures, Air Force Reserve PS accessions reports in 1977 contain errors. We adjust all Air Force Reserve PS accessions figures upward by 29.5 percent to correct these errors.

¹⁰McNaught, op. cit.

Table 5
ESTIMATES OF THE DoD-WIDE PS RESERVIST SUPPLY FUNCTION

Variable	Coeff.	t-value	Elast.	Coeff.	t-value	Elast.
Military pay ^a	0.2257	0.32	0.20	-0.1683	-0.15	-0.15
Primary pay ^a	0.0077	0.23	0.11	-0.0125	-0.24	-0.02
Secondary pay ^a	-0.0667	-1.89	-0.38	-0.0673	-1.24	-0.39
Unemployment	0.0357	1.13	0.24	0.0740	1.54	0.49
Primary hours	0.0225	0.54	0.90	-0.0097	-0.15	-0.39
Percent reservists ^b	0.2122	7.11	0.87	--	--	--
Percent rural	0.3952	1.21	0.26	-0.6277	-1.39	-0.42
Regional dummies						
Mid Atlantic	-0.0761	-0.58	--	-0.2407	-1.21	--
East North Central	-0.5299	-3.57	--	-0.6236	-2.74	--
West North Central	-0.5639	-3.24	--	-0.4721	-1.76	--
South Atlantic	-0.1180	-0.74	--	-0.1657	-0.68	--
East South Central	-0.0508	-0.26	--	0.1926	0.66	--
West South Central	-0.1424	-0.76	--	-0.0085	-0.03	--
Mountain	-0.4297	-2.33	--	-0.2593	-0.92	--
Pacific	-0.5743	-3.32	--	-0.5621	-2.11	--
Constant	-3.0335	-1.84	--	0.1191	0.05	--
R ²		.849			.631	
F(15,35)		13.106			4.392	
Number of observations		51			51	

^a Measured in thousands of dollars.

^b Participating reservists per thousand persons.

used in both analyses more closely approximates the employment prospects of PS personnel.

The coefficient of primary hours is positive, rather than negative, as theory would predict. The high elasticity for primary hours observed for NPS enlistments could therefore reflect difficulty in completing initial active duty training rather than difficulty in finding leisure hours to attend drills and summer camp.

The pattern of regional dummies is quite different from that of the NPS equation. The omitted New England region has the highest coefficient. Also four of the eight dummies are significant. Enlistment propensities across states seem to differ markedly between NPS and PS personnel.

The most significant variable in the equation is recruiting effort (percent of population participating in the reserves). Its elasticity is high relative to others in the equation, but lower than the 1.13 elasticity found for NPS personnel. As was the case for the NPS analysis, interpretation of this finding is complicated by the possible presence of biases due to spurious correlation introduced by scaling both recruiting and enlistment rates according to population, and the omission of important variables that could have induced high accession rates in prior years.

INDIVIDUAL COMPONENT SUPPLY ANALYSIS

At this point in the narrative, our next logical step should be the disaggregation of our measure of reserve supply to examine the supply functions of the individual components. Although we examined a number of possible models of individual component supply, we did not find one that provided consistent results across all components. Some speculation about the reasons behind this failure will provide useful insights into the nature of reserve supply and the problems encountered in its investigation.

The first problem is one of measurement. The rate of accessions into the reserve forces is infinitesimal: On the order of two young males in a thousand enlist each year. Also relatively small changes in incomes result from a decision to serve. A recent survey of reservists

indicated that the average reservist with six years of service receives less than 10 percent of his or her total income from the reserves.¹¹ In the NPS case, then, we are attempting to distinguish very improbable outcomes based upon data elements not nearly accurate enough for the task. In some respects it is remarkable that the results we obtain from the simple economic model are as reasonable as we have found. To the extent we disaggregate our analysis, these measurement problems increase greatly, particularly in the non-Army components. These problems are somewhat eased in PS analysis, but still remain formidable.

A second problem encountered in a disaggregate individual component analysis is the need for more powerful econometric techniques. In an individual component analysis, a prospective enlistee faces not a simple choice of enlistment or non-enlistment, well modeled by the dichotomous logit regression method used here, but a complex choice between non-enlistment and six different enlistment options. This more complex choice requires the use of the multinomial logistic model.

A third problem is the tendency for each component to establish its own prime recruiting territory. For the smaller components, such as the Navy and Marine Reserves, this concentration on only a few areas is mandated by the small number of units they maintain. Table 6 shows the simple correlations between the NPS accession rates in five of the six components. Only the Army Reserve and the Air National Guard have markedly similar recruiting areas.

Table 6

SIMPLE CORRELATIONS BETWEEN MALE HIGH QUALITY NPS ACCESSION
RATES AMONG THE SELECTED RESERVE COMPONENTS

Component	ARNG	USAR	USMCR	ANG	USAFR
ARNG	1.00	.25	-.22	.33	.09
USAR		1.00	.10	.61	.33
USMCR			1.00	.10	-.13
ANG				1.00	.32
USAFR					1.00

¹¹ D.W. Grissmer and Z.B. Doering, The Selected Reserve Reenlistment Bonus Experiment: Initial Results, The Rand Corporation (forthcoming).

A final problem is the difficulty in identifying the demand for recruits separately from reservist supply. As described at the beginning of this section, components in some states might turn away willing enlistees because units are full. In those cases, the true supply of reserve enlistees is unobservable.

Appendix A presents results comparable to those of Tables 4 and 5 for five of the components. Although in most instances the pay elasticities resemble the ones presented in those tables, they vary greatly across the components. The pattern of NPS and PS results tends to be consistent within a component, however.

One heartening implication of these individual component results is the much larger effect of recruiting effort (percent of the state population participating in the reserves) on enlistments within the two Guard components than within the Reserve components. The potential problem of spurious correlation associated with this variable is identical across all the components and could not account for this pattern in the results. However, if this variable does represent differences in recruiting efforts as we hope, we would expect precisely this pattern, in which an informal network of friendships is more important to the reserve participation decisions of Guardsmen and Guardswomen than to Reservists.

V. LESSONS LEARNED

Although this analysis has provided a number of useful insights about the reserve enlistment process, we believe that it would be dangerous to advocate policy initiatives based purely on these results. The size of the data base is too small and the intricacies of the analysis too great to support such a course at present. With this clear caveat about the meaning of these results, this section summarizes the lessons learned from this analysis and suggests some fruitful avenues for future studies of reservist supply.

THE VALUE OF THE PAY ELASTICITY

Table 7 summarizes the estimates of three important pay elasticities presented in Sec. IV. As point estimates, all 12 fall in the inelastic range. Of the 12 elasticities, the largest in absolute value is only .55. Both the primary and military pay elasticities' signs are unstable across the specifications--each differs from the "correct" sign twice in four instances. The size and sign of the secondary pay elasticity are consistent across both types of accessions and the two specifications.

Table 7

ESTIMATED PAY ELASTICITIES OF RESERVIST SUPPLY

	Specification Including a Recruiting Variable		Specification Excluding a Recruiting Variable	
	NPS	PS	NPS	PS
Military pay	+0.15 ^a	+0.20	-0.26 ^a	-0.15
Primary pay	+0.43 ^a	+0.11 ^a	-0.23	-0.02
Secondary pay	-0.38	-0.38 ^{a, b}	-0.55	-0.39 ^a

^aStatistically different from one at 10 percent level of significance.

^bStatistically different from zero at 10 percent level of significance.

In general, the statistical significance of these estimates (as compared with no pay effect whatsoever) is not high. Only the PS secondary pay elasticity in the first specification is significantly different from zero. If we choose a null hypothesis of a unitary pay elasticity instead of a completely inelastic response, we can reject the null hypothesis for six of the 12 elasticities.

Although these results cast more doubt upon an elastic reservist supply than a completely inelastic one, the uncertainty remaining in these estimates is large enough to prevent us from ruling out either case. Because the original goal of this study was the improvement of our knowledge of this reservist pay elasticity, this continuing imprecision about the nature of reservist supply is disappointing.

The difficulty of the analytic task places these results in some perspective. We mentioned in Sec. II that previous estimates of the reservist pay elasticity were widely divergent. That section also listed a number of complications to the model of secondary labor force participation which could have biased this analysis. Difficulties with the available data, described in Sec. III, proved to be even more formidable than the theoretical problems.

Situations in which analysis cannot resolve uncertainty about key policy parameters are not uncommon in labor research. DaVanzo, DeTray, and Greenberg review a number of studies of civilian labor supply and find a range of supply elasticities from -0.68 to $+0.96$.¹ Estimates of the pay elasticity for active duty accessions into the Army range from $+0.35$ to $+2.40$.²

Given the present state of knowledge about reserve behavior, policymakers must consider the uncertainty about reserve participation when deciding about any reserve personnel initiative. They have not done so in the past. Reserve force planners have usually assumed a unitary supply response, even though little evidence supports this

¹DaVanzo, DeTray, and Greenberg, op. cit.

²Alan E. Fechter and Dorothy Amey, "Review of the Literature: Summary of Findings," Chap. 3, in Dorothy M. Amey et al., Econometric Models of Armed Forces Enlistment Levels, General Research Corporation, October 1976.

assumption. For example, the Reserve Compensation System Study evaluated its own recommendations for alterations in the structure of reserve pay by stating:

Review of the continuation elasticities required for NPS and PS personnel also appear reasonable when considering the RCSS differential pay schemes. These required elasticities indicate that the RCSS pay proposal, with judicious use of differential pays, can provide the continuation rates necessary to acquire the DoD aggregate years of service objective if the actual supply response coefficient is between .80 and 1.2. If the actual coefficient is 1.0, as some early research suggests, this analysis indicates that the Reserve Components could begin to be selective in the early critical years of service upon implementation of the RCSS proposal.³

Continued use of relatively high pay elasticities without consideration of equally likely low values could lead to an overreliance upon pay incentives as a policy mechanism for increasing manning levels of the selected reserve forces. Even if planners should determine that pay incentives are efficient over a wide range of supply responses, use of the unitary elasticity assumption could cause serious underestimates of program costs.

RECOMMENDATIONS FOR FUTURE RESEARCH

Given the increasing importance of the reserve forces to the nation's security, further research of this type is clearly warranted. Perhaps this study's major contribution is the suggestions which it can offer to assist this research. We suggest that future researchers:

- o Account for both economic and social effects within their model.
- o Embed any accession analysis within a larger model of the total personnel system.
- o Address interactions between the components' personnel systems.
- o Collect data at the finest level of detail possible.

³Reserve Compensation System Study, Final Report, Office of the Deputy Assistant Secretary of Defense (Reserve Affairs), June 1978, pp. VI-125-126.

One possible research strategy would use individual reserve units, rather than states, as the basic unit of observation. Our choice of the state as the observation unit for this study was dictated by the ease of data collection which it afforded. As is so often the case, the easy way proved not to be the best way.

Analysis by reserve unit would drastically increase the sample size and thus directly improve the precision of all statistical results. It would improve the measurement of the characteristics surrounding the reserve unit by allowing the use of SMSA data (Standard Metropolitan Statistical Area). Most usefully, it would replace tallies of authorized positions as measures of the demands for personnel with militarily meaningful concepts of unit mission and deployment date.

Concentrating on reserve units as entities themselves vastly increases the potential for analyzing the sociology of reserve participation. If the informal recruiting network within reserve units is as important as we think it is, any useful model of the reserve supply decision must incorporate variables for the esprit de corps and friendships associated with reserve service.

A 1979 Department of Defense survey of personnel in a selected sample of Army Guard and Army Reserve units could provide important data for this task. This survey contains information about the socioeconomic characteristics of reservists and their attitudes toward reserve service. The socioeconomic data would provide an invaluable check against the measured SMSA economic characteristics. The attitudinal data would provide a basis for a more complete analysis of the role of social factors in the reserve supply decision.⁴

The future models of reservist supply could be based upon the one we have developed here. Integrating the econometric approach with the sociological methods inherent in the survey measurements would require careful thought. New models should include variables that assess how recruiting activities in other components affect

⁴See the following for discussions of this data base: Z. Doering, D. Grissmer, and J. Hawes, The 1979 Reserve Forces Survey: Survey Design and Administrative Procedures, The Rand Corporation, forthcoming.

accession rates into the unit. Also, the decentralized nature of the reserve personnel system may require future researchers to extend their models to encompass demand, supply, and readiness phenomena simultaneously.

We do not minimize the difficulty of accomplishing this analytical task. Assembling and analyzing a complex data base of this magnitude will be no small task. The combination of disparate econometric and sociological models presents a formidable challenge. The importance of the reserve supply problem and the potential insights to be obtained from the analysis make the task worth the effort.

Appendix

RESERVE SUPPLY ELASTICITIES FOR THE INDIVIDUAL COMPONENTS

The model constructed and estimated in this Note can be applied to each reserve component individually. Four possible specifications --(1) NPS with a variable for recruiting effort, (2) NPS without a variable for recruiting effort, (3) PS with a variable for recruiting effort, and (4) PS without a variable for recruiting effort--provide results analogous to those presented in Tables 4 and 5 of Section IV. Below we present the elasticities calculated from estimates of these four specifications for five of the six components. We eliminate the Air Force Reserve from this analysis because of the reporting errors found in their FY 1977 accessions reports. We eliminate the two specifications for the NPS equation for the Naval Reserve because only four sailors without prior military service enlisted in the Naval Reserve in 1977.

Table A-1

SUPPLY ELASTICITIES CALCULATED FROM AN NPS EQUATION
INCLUDING A VARIABLE FOR RECRUITING EFFORT

	ARNG	USAR	USMCR	ANG
Military pay	.76	-1.55	.52	-.85
Primary pay	.53	-.30	.27	.82
Secondary pay	-.35	-.39	-.25	-.53
Unemployment	1.05	-10.56 ^a	-8.21	-3.29
Primary hours	-.16	.60	.11	.73
Percent reservists	1.37 ^a	.67 ^a	-.35	1.30 ^a
Percent rural	.46	.10	.96	.36

^aSignificant at the .01 level.

Table A-2

SUPPLY ELASTICITIES CALCULATED FROM AN NPS EQUATION
EXCLUDING A VARIABLE FOR RECRUITING EFFORT

	ARNG	USAR	USMCR	ANG
Military pay	.35	-1.86 ^a	.58	-1.50 ^c
Primary pay	-.28	-.72	.35	-.12
Secondary pay	-.52	-.53	-.18	-.66
Unemployment	.22	.78 ^c	.003	.82
Primary hours	-2.41	-13.08 ^a	-7.07	-11.29 ^b
Percent rural	-.65	-.34	1.16 ^c	-.50

^aSignificant at the .01 level.

^bSignificant at the .05 level.

^cSignificant at the .10 level.

Table A-3

SUPPLY ELASTICITIES CALCULATED FROM A PS EQUATION
INCLUDING A VARIABLE FOR RECRUITING EFFORT

	ARNG	USAR	USNR	USMCR	ANG
Military pay	.17	-.36	1.44 ^b	1.00	-1.93 ^c
Primary pay	.49	-.48	-1.46 ^a	-.44	1.60
Secondary pay	-.49	-.06	-.20	-.48	-.46
Unemployment	.17	-.06	.20	1.18 ^c	.31
Primary hours	3.08	-2.92 ^c	4.14 ^a	-8.45	-4.77
Percent reservists	1.05 ^a	.38	-.07	-.36	.83 ^a
Percent rural	-.21	.37	.60 ^a	.94	-.72 ^c

^aSignificant at the .01 level.

^bSignificant at the .05 level.

^cSignificant at the .10 level.

Table A-4

SUPPLY ELASTICITIES CALCULATED FROM A PS EQUATION
EXCLUDING A VARIABLE FOR RECRUITING EFFORT

	ARNG	USAR	USNR	USMCR	ANG
Military pay	-.28	-.41	1.43 ^b	.96	-2.71 ^b
Primary pay	.02	-.06	-.14 ^a	-.04	.12
Secondary pay	-.48	-.07	-.20	-.45	-.37
Unemployment	.50	.11	.14	1.00 ^c	.45
Primary hours	1.44	-3.56	4.23 ^a	-7.13	-6.19 ^a
Percent rural	-1.04 ^b	.12	.65 ^a	1.14 ^c	-1.35 ^c

^aSignificant at the .01 level.

^bSignificant at the .05 level.

^cSignificant at the .10 level.

