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Enlistment supply at the local market level

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by

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May 15,2000

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. ABSTRACT (Maximum 200 words.)

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ABSTRACT

Most previous studies of military enlistment supply have used data aggregated to a specific geographic level, often the recruiting district level. **A** major disadvantage of aggregated data is that the district is not the primary level at which resources are allocated or recruiting activities occur. Rather, recruiters are assigned to stations and each station is responsible for a set of zip codes, which define its market territory. Thus, existing research does not provide information that would assist in identifying the best geographic areas in which to locate recruiters or stations. This paper exploits a unique data file constructed from the basic building blocks of recruiting markets – zip codes. The paper seeks to measure the effects of geographic location, especially of recruiters and stations, on enlistment supply for the Navy and Army. In addition, the data allows an examination of inter-service competition among recruiters, including the effect of collocation in the same station. The paper finds own-service recruiter elasticities that are comparable to those estimated in other studies. It also finds that the number of other-service recruiters tend to have a complementary effect on a given service's enlistments. Furthermore, collocation of recruiters of two services in a station does not harm the recruiting success of each service. The greater the average distance between a station and the zip codes in its market tends to reduce enlistments, while the presence of a station in a **zip** code tends to have a positive effect on recruiting. These results suggest that geographic location of stations is important for recruiting success. The paper provides new evidence on the market level impact of recruiting resources, including facilities and recruiters, which can be used to guide decision makers in choosing geographic locations of recruiting resources.

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I. Introduction

Economists have been interested in estimating military enlistment supply models at least since the advent of the all-volunteer force in 1973. In the 25 years since the AVF was launched, numerous econometric supply studies have been published. Goldberg (1982) surveys studies as of the early 1980s, and Warner and Asch (1995) survey the literature as of the early 1990s. This research has yielded an impressive array of fairly consistent and useful results. From a labor economics perspective, enlistment supply models have improved our understanding of the behavior of youth in making post-high school occupational and schooling decisions. From a policy standpoint, the models have yielded measures of the relative effectiveness of alternative recruiting tools and incentives. From a resource management standpoint, they have provided practical methods for forecasting future supply.

Most prior studies have used data aggregated to a specific geographic level, often the recruiting district. Recruiting districts consist of parts of large states or portions of several smaller states. For example, the Navy recruiting command is currently organized into **31** geographic districts, and the Army command into **41** districts. The advantage of these data is that a recruiting district represents one of the important hierarchical levels in a service's recruiting organization, and one where enlistment quotas are assigned and recruiting success (generally measured by gross contracts) is monitored closely. However, a major disadvantage of this type of data is that the district is not the primary level at which resources, especially recruiters, are allocated within recruiting organizations.

An individual recruiter does not recruit throughout an entire district. Rather, each recruiter is assigned to a recruiting facility and is allowed to canvass only within that station's pre-assigned geographic territory. Each station's territory consists of a set of contiguous zip codes.

Results drawn from models estimated with district-level data cannot be used to analyze the numerous decisions that must be made within districts at the local geographic level. These decisions include the number and location of recruiting stations, the assignment of recruiters to those stations, the geographic configuration and size of each station's territory, and the quota of each station. More importantly, models that use district data cannot provide estimates of the direct impact of the recruiting station, or more precisely, its location.

The purpose of this paper is to exploit a unique data file constructed from the basic building blocks of recruiting markets, zip codes. The data file identifies the geographic location of stations, the recruiters assigned to each station, the market territory (zip codes) which belong to each station, and the enlistment contracts originating from each zip code. The major goal of the paper is to test hypotheses on the effects of geographic location, especially of recruiters and stations, on enlistment supply. For example, the data identify the distance that recruiters must travel from the recruiting station to each zip code in their market area. Greater distances increase the time cost of canvassing in a given zip code and, all else equal, reduce the expected number of contracts from that zip code. A secondary purpose of this study is to improve the efficiency of estimates of the standard variables, such as recruiters and local unemployment, in prior enlistment supply models based on aggregate data.

One important issue that can be addressed with these data is the effect of one service's recruiting efforts on another service's enlistment contracts. Interest in the inter-service competition issue has been stimulated by a recent General Accounting Office (GAO, 1994) report recommending that the services consider consolidating more recruiters into collocated stations. GAO's recommendation stems in part from the belief that individual service recruiting efforts are competitive, so that consolidating recruiters into joint facilities can reduce costs to

DOD without harming overall recruiting success. Unfortunately, evidence on this issue is limited, and the evidence that is available does not always support the presumption that recruiting efforts are competitive. Also, no previous studies have examined this issue using data disaggregated to the local geographic level where individual recruiters interact, often within the same station.

The paper is organized as follows. Section II provides a brief review of some of the pertinent issues in the enlistment supply literature. Section III presents a brief overview of the theory underlying our specification. Section IV discusses the pooled data, and section V discusses model specification and estimation methods. Results are presented in Section VI, and Section VII summarizes the paper and suggests directions for the future.

II. Literature Review

Several prior studies have used data from a time series of cross sections to analyze enlistment supply. One reason for using pooled district-level data is the wealth of information available on recruiters, advertising, and enlistment contracts. **A** second reason is that in pooled data variation of key variables, such as military pay, civilian pay and unemployment, is greater than in either cross sectional or time series data alone. To deal with potential bias arising from demand constraints on enlistments, most studies have focused on high quality enlistments, defined as high school diploma graduates in AFQT test score categories I to IIIA. The assumption behind this approach is that the services seldom meet their quotas for high quality enlistments and therefore estimated parameters are more likely to represent true structural supply effects.

A major issue in enlistment supply studies using pooled data is the effect of unobserved factors that vary across the cross sectional units, but that are time-invariant. In OLS estimates of supply models if the unobserved factors (such as propensity) are correlated with the included variables, parameter estimates will be biased. Examples of unobserved factors include differences in underlying military propensities, command-specific factors, and recruiting effort (see Kostiuk, 1987). One technique for eliminating the bias due to unobservable factors is to estimate fixed effects models (see Johnston and DiNardo, 1994).

Brown (1985) analyzed the determinants of Army contracts using quarterly data from states for 1976-1982. He analyzed contract rates for four different quality groups, based on high school diploma and AFQT score combinations. Fixed effects models were estimated to deal with unobserved factors associated with states. His model specification includes only military pay, civilian pay, educational benefits, and unemployment rates. Prior to Brown, there had been some controversy over the effect of unemployment on recruitment, with some studies having found no effect. Brown, by contrast, found very large effects of unemployment on recruitment success, with elasticity estimates around .42. The elasticity of military pay was estimated to be around .50.

The omission of recruiters from Brown's supply model represents a potential specification error. In a footnote, Brown indicates that additional Army recruiters had a positive effect on enlistments and that additional recruiters from the other services had a negative effect. However, he does not present any models that include recruiters in the specification. Brown's caution on this point may stem from his inability to accurately assign recruiters to states. The difficulty arises because states are not aligned naturally with recruiting districts. Because the author was forced to arbitrarily assign pro-rated shares of recruiters to each state, the number of recruiters by state is likely to have been measured with error, which would produce biased estimates due to the correlation between the included variables in the model and the error term.

Daula and Smith (1985) used monthly data from Army districts (battalions) pooled for the period from October 1980 through June 1983 to estimate high quality enlistment equations. They estimated standard OLS models, fixed effects models, and instrumental variables models. One of their more interesting findings was that increases in the number of high quality enlistments by the other services had a large negative effect on the supply of Army recruits. In particular, the Army lost one high quality enlistee for every two to three additional other service enlistments in a district. The authors also divided the sample into observations drawn from supply-constrained environments (quota < supply) and observations from demand constrained environments (quota > supply) and estimated separate models for both. **As** expected, the effects of most determinants (pay, unemployment, recruiters, and advertising) were smaller for the demand-constrained sample.

Warner (1990) reports the results of estimating supply models using quarterly data for 1981-1987 for Navy recruiting districts. An advantage of these data is that he is able to incorporate district recruiting goals to control for demand constraints. He estimates separate models for each of the four services and incorporates the effects of each service's own recruiters, other services' recruiters (all other services are combined), own-service goals, and other service goals.'

Warner points out that the effect of district population in enlistment studies is especially important because each service distributes recruiters to districts primarily on the basis of population size. **As** a result, standard **OLS** regressions will be dominated by the positive cross sectional correlation between recruiters and enlistment data at a point in time and will therefore be biased toward finding a positive relationship between recruiters (of all services) and enlistments. That is, they will be biased toward finding complementarity among recruiters. Because fixed effects models convert the data to a within-district time series, changes in recruiters over time are

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[1] Warner points out that there may be important difference between the effect of **an** increase in **an** individual service's recruiters versus an increase in its goal. If the Navy, for example, expands recruiters without expanding goals, recruiters can achieve goal with less effort, which may serve to boost the other services' contracts. But if Navy increases the goal for a fixed number of recruiters, Navy recruiters will be induced to work harder, which may damage other services' recruiting.

less highly correlated, leading to improved estimates of the interservice recruiting relationship.

Warner's estimates reveal substantial complementarity among the services' recruiting efforts: with the exception of the Marine Corps, an increase in other-service recruiters increases own-service contracts. The lowest cross-service elasticity was .06 for the Air Force and the highest was .60 for the Army. Increases in other service goals have a mixed effect: they increase contracts for the Navy and Air Force but reduce them for the Army.[2] The effect of unemployment in Warner is similar to Brown's results, with elasticities in the .40-.50 range for three of the services and around .20 for the Air Force. The pay elasticities varied by service ranging from .50 for the Army to over 2.0 for the Navy and Marine *Corps*. Warner also found that educational benefits were a major factor in improving Army and Navy recruiting success in the 1980s. Advertising expenditures had a consistently positive enlistment effect only for the Army, results that are in line with other studies of the impact of advertising.

III. Background

The traditional approach in most enlistment supply research, is to view the enlistment decision as an occupational choice (Goldberg, 1991). Guided by the underlying theory of occupational choice, and based at least implicitly on utility maximization, factors postulated to influence supply include the pecuniary and non-pecuniary aspects of employment in the Armed Forces relative to the next best alternative. Hence, the typical supply model is specified to include measures of military pay, civilian pay (representing the opportunity cost), the state of the civilian economy, typically measured by the unemployment rate, and other variables affecting the relative

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[2] Note that Warner did not have &strict-level goal information for the Air Force **and** Marine *Corps* thus creating measurement error in this variable.

attractiveness of military service.

In this analysis, we do not focus on the estimation of structural parameters for the effects of pay, bonuses, and other recruiting resources that affect the inherent relative attractiveness of military service. **As** noted above, much of the econometric literature has been devoted to estimating the effects of these factors. Rather, we focus on two resources that affect enlistment supply largely by reducing the information costs of enlistment opportunities to potential applicants and the direct cost to the applicant of completing the application process. These resources are military recruiters and the recruiting stations from which they operate, and the geographic location of the stations. In this sense, we can view the analysis as that of a firm selling a product—in this case, employment in the armed forces.

Military recruiters are typically included in enlistment supply equations because they represent the military's sales force. They are usually found to have a positive and statistically significant effect on enlistments. The theory underlying the role of recruiters in enlistment supply is rarely articulated, however. The framework for understanding the role of recruiters is one where information regarding job opportunities, job characteristics, and the steps necessary to apply and qualify is imperfect and costly for potential applicants. Recruiters reduce the cost of information regarding opportunities in the military to potential applicants and reduce the cost of applying for entrance to the military, which should increase the pool of potential applicants and the number of applicants from the pool.

In contrast to military recruiters, the role of recruiting facilities in enlistment supply has not been analyzed.[3] Recruiting stations potentially increase the supply of recruits in four related

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3 An exception to this is Bohn et al. (June 1996).

ways. First, the number and locations of recruiting stations may have a direct effect on recruiter productivity. **A** station serves as the office to which recruiters report, where they canvas for potential applicants, and where they test and process applicants. The closer the recruiter's office is to potential applicants the less travel time the recruiter will incur per call and the more time that will be available to for essential recruiting activities. Second, recruiting stations can serve as the equivalent of retail outlets in that they reduce the cost to potential applicants of obtaining information regarding enlistment opportunities. By affecting the potential applicant's travel time and direct expenses, they reduce the cost of applying. "Walk-in" traffic should be greater the larger the number of conveniently located outlets. Trips to the station to discuss aspects of military service or the application process with a recruiter are less costly to the applicant the closer the station is to the applicant. Third, recruiting stations themselves may be a form of advertising—a "billboard"—that can lower the cost of information to potential applicants. Finally, and related to the first reason, recruiting stations affect direct travel expenses—mileage costs, etc.—and the direct costs of sales production. Hence, for a given budget, lower travel costs mean that resources can be reallocated to other recruiting tools.

The issue of the optimal number and location of recruiting stations and the way they potentially affect enlistments is related to the theory of spatial competition. This theory, based on Hotelling (1929) and Smithies (1941) provides the important insight that the full price of a good or service is equal to its nominal purchase price plus the cost to the purchaser of traveling to the outlet to receive the good, or the cost of having the good shipped to the purchaser. The theory of spatial competition provides some insight regarding where profit-maximizing firms will locate plants or retail outlets. It can be extended to include multiple plants or outlets, and the degree of competition in the market. Elementary aspects of the theory of spatial competition suggest that outlets should be located in areas central to the potential customers. With respect to recruiting stations the simple theory suggests that, holding other factors constant, the relationship between enlistments and the distance between the geographic areas served by a station and the station itself will be negative.

For our purposes, we test the following hypotheses:

- holding other factors constant, there will be a negative relationship
- the distance between a recruiting stationll have a positive effect on enlistments in the areas where they are located;
- the effect should be greater in areas with more potential applicants;
- recruiting stations of competing services (close substitutes to the own service) have a negative effect on enlistments from the local area.

IV. Data

Following prior studies, this paper attempts to model behavior of male "high quality" enlistments—high school diploma graduates who score in the top half of the Armed Forces Qualifying Test (AFQT). Observed enlistments from this group are assumed to represent supply behavior, in that these groups are not demand constrained. Supply models are estimated for two separate geographic levels—the ZIP code level and the station (market) level. The analysis focuses on the interaction between Army and Navy recruiters.

Most of the data on enlistment contracts is from the Army's ATAS database, which provides quarterly contracts by ZIP code, from the fourth quarter of fiscal 1994 through fourth quarter of fiscal 1997, a total of thirteen quarters. It also includes ZIP code demographics, including the ***17-21*** year old population, area in square miles, and the number of high schools. Importantly, it includes the location of the Army station that serves each ZIP code and the number of recruiters assigned to each station.

Data on Navy contracts is taken from Navy's STEAM database. This database also includes data regarding the number of Navy production recruiters assigned to a recruiting station each quarter, the ZIP codes in that station's territory, as well as the ZIP code in which the recruiting station is located. In addition, we have added data on per capita income and median household income from the 1990 Census. This data, while available at the ZIP code level, provides only a cross-sectional snapshot for the period of the Census. There is no time series variation and the data is eliminated in fixed effects estimates. The county unemployment rate is also included in some specifications.

Each service's data identifies recruiters assigned to a given recruiting station and the ZIP codes assigned to that station. To measure recruiter presence in each ZIP code, we allocate each station's recruiters to each zip code in the station's territory based on the proportion of the population of ***17-21*** year olds in each ZIP to the total population in the station's market area:

$$ZI\,\mathrm{Pr}\,\boldsymbol{ecruiters} = \boldsymbol{Stationrecruiters} * \frac{ZIPpop17-21}{Stationpop17-21}$$

We believe that this distribution is preferred to assigning all of the station's recruiters to every ZIP code in its market territory in that it accounts for the competing demand for a recruiter's time across the ZIP codes assigned to a station.

We construct estimated distances from each ZIP code in a station's territory based on the radial distances between the centroid of the ZIP code and the centroid of the ZIP code where the recruiting station is located (centroids are identified by latitude and longitude). For those ZIP codes where the facility is located, the distance is calculated as the radius of a circle with the same area as that of the ZIP code.

Finally, the Army and Navy identified the ZIP code in which their respective recruiting stations are located. This information was used to construct a third variable indicating whether both Army and Navy have a station in a given ZIP code. We interpret this to be a "co-located" or "joint" recruiting station, though we do not know with certainty that they are located in the same building.[4]

Table 1 provides a brief glossary of variable definitions. Descriptive statistics for our data are shown in the following tables. Table 2 contains the means and standard deviations for the ZIP code-level Army data and Table 3 displays the means and standard deviations for the Navy data. Table 4 provides the definitions of the variables measured in logarithms. Table 5 presents means of the logs of the ZIP code level data. In Tables 6 and 7, the means and standard deviations for the station-level models, in log form, are presented for the Army and Navy, respectively.

[4] DOD policies generally prevent any two services from leasing separate facilities in close proximity to each other.

Table 1: Glossary of Variables

Variable Name	Description
AR_GSMA	Army male I-IIIA HS diploma grads
AREA	Area covered by ZIP code or station in square miles
ASTATZIP	Dummy for Army station in ZIP code
DISTAR2	Distance to ZIP of Army station from centroid of ZIP
DISTNAV	Distance to ZIP of Navy station from centroid of ZIP
FY96	Dummy for FY 96
HSI	Dummy for exactly I high school in ZIP
HS2	Dummy for 2 or more high schools in ZIP
HSREC_A	Interaction of dummy for 1 or more high schools in ZIP with number f Army re ruiters
HSREC_N	Interaction of dummy for 1 or more high schools In ZIP With number of Navy recruiters
HSSTZ_A	Interaction of dummy for 1 or more high schools In ZIP with dummy for Army station in ZIP
HSSTZ_N	Interaction of dummy for 1 or more high schools in ZIP with dummy for Navy station in ZIP
JOINTZIP	Dummy for Army and Navy stations in same ZIP
NSTATZIP	Dummy for Navy station in ZIP
NV_GSMA	Navy male I-IIIA HS diploma grads
PERCAPIN	Per-capita Income from 1990 census
POP17	Population of 17-21 year olds
POPDEN	Population density of 17-21 year olds
PROREC_A	Number of prorated Army recruiters by population in ZIP
PROREC_N	Number of prorated Navy recruiters by population In ZIP
PRORECA2	Square of prorec_a
PRORECN2	Square of prorec_n
Q2	Dummy for 2nd fiscal quarter
Q3	Dummy for 3rd fiscal quarter
Q4	Dummy for 4th fiscal quarter
RC_POP_A	Interaction of prorated Army recruiters with 17-21 year old population
RC_POP_N	Interaction of prorated Navy recruiters with 17-21 year old population
RECINC–A	Interaction of prorated Army recruiters with per-capita In me
RECINC_M	Interaction of prorated Navy recruiters with per-capita Income
RECPPOP	Ratio of Army recruiters at a station to the 17-21 year old population that their station serves
STZINC–A	Interaction of Army station dummy with per-capita Income
STZINC_N	Interaction of Navy station dummy with per-capita Income
STZIPOPA	Interaction of Army station dummy with 17-21 year old population
STZIPOPN	Interaction of Navy station dummy with 17-21 year old population
STZPSUBA	Interaction of Army station dummy with suburban dummy
STZPSUBN	Interaction of Navy station dummy with suburban dummy
STZPURBA	Interaction of Army station dummy with urban dummy
STZPURBN	Interaction of Navy station dummy with urban dummy
STZREC–A	Interaction of Army station dummy with number of prorated Army recruiters
STZREC_N	Interaction of Navy station dummy with number of prorated Navy recruiters
SUBREC–A	Interaction of suburban dummy with number of prorated Army recruiters
SUBREC_N	Interaction of suburban dummy with number of prorated Navy recruiters
SUBURB	Dummy for suburban ZIP
URATE	County unemployment rate
URBAN	Dummy for urban ZIP
URBREC_A	Interaction of urban dummy with number of prorated Army recruiters
URBREC_N	Interaction of urban dummy with number of prorated Navy recruiters

Table 2: Descriptive Statistics for Army ZIP Level Data

Variable	Mean	Std Dev
AR_GSMA	0.4208	1.0380
PROREC_A	0.5567	1.1436
PROREC_N	0.3687	0.8624
PRORECA2	1.6176	12.9140
PRORECN2	0.8796	7.1216
RECINC_A	7541.2600	15651.9600
RC_POP_A	965.0105	5737.1900
STZREC_A	0.1144	0.7495
URBREC_A	0.3577	1.0826
SUBREC_A	0.1222	0.5213
HSREC_A	0.4073	1.0679
ASTATZIP	0.0615	0.2402
NSTATZIP	0.0534	0.2248
JOINTZIP	0.0435	0.2040
STZIPOPA	82.4604	480.5024
STZINC–A	848.0257	3499.5000
STZPURBA	0.0395	0.1947
STZPSUBA	0.0213	0.1443
HSSTZ_A	0.0529	0.2238
POP17	417.9071	754.9784
AREA	107.2245	388.3624
POPDEN	54.0096	212.0492
DISTAR2	41.0314	56.6939
DISTNAV	46.5696	73.0890
PERCAPIN	12608.9800	5860.8600
URATE	0.0561	0.0245
URBAN	0.2884	0.4530
SUBURB	0.1434	0.3505
HS1	0.4147	0.4927
HS2	0.0896	0.2855

Table 3: Descriptive Statistics for Navy ZIP Level Data

Variable	Mean	Std Dev
NV-GSMA	0.2851	0.7924
PROREC_A	0.5567	1.1436
PROREC_N	0.3687	0.8624
PRORECA2	1.6176	12.9140
PRORECN2	0.8796	7.1216
RECINC_N	4991.9000	12138.8000
RC_POP_N	681.3250	4229.4300
STZREC_N	0.0608	0.4901
URBREC_N	0.2474	0.8163
SUBREC_N	0.0757	0.3660
HSREC_N	0.2689	0.7922
ASTATZIP	0.0615	0.2402
NSTATZIP	0.0534	0.2248
JOINTZIP	0.0435	0.2040
STZIPOPN	74.0224	457.7097
STZINC_N	749.8068	3319.7800
STZPURBN	0.0360	0.1863
STZPSUBN	0.0169	0.1289
HSSTZ_N	0.0453	0.2080
POP17	417.9071	754.9784
AREA	107.2245	388.3624
POPDEN	54.0096	212.0492
DISTAR2	41.0314	56.6939
DISTNAV	46.5696	73.0890
PERCAPIN	12608.9800	5860.8600
URATE	0.0561	0.0245
URBAN	0.2884	0.4530
SUBURB	0.1434	0.3505
HS1	0.4147	0.4927
HS2	0 0896	0.2855

Table 4: Definition of Log Variables

Variable Name	Description
LNAREA	Log of Area
LNARGSMA	Log of Army male I-IIIA HS diploma grads
LNAVDSTA	Log of population-weighted average distance to Army station from ZIPs served by that station
LNAVDSTN	Log of population-weighted average distance to Navy station from ZIPs served by that station
LNDIST–A	Log of distance to ZIP of Army station from centroid of ZIP
LNDIST_N	Log of distance to ZIP of Navy station from centroid of ZIP
LNDISTAR	Log of distance to Army station from nearest Navy station (station-level model only)
LNDISTNV	Log of distance to Navy station from nearest Army station (station-level model only)
LNNVGSMA	Log of Navy male I-IIIA HS diploma grads
LNPCAPIN	Log of per-capita income from 1990 census
LNPOP17	Log of population of 17-21 year olds
LNPRORCA	Log of prorated number of Army recruiters in ZIP of Navy station (station-level model only)
LNPRORCN	Log of prorated number of Navy recruiters in ZIP of Army station (station-level model only)
LNREC–A	Log of prorated number of Army recruiters in ZIP
LNREC–N	Log of prorated number of Navy recruiters in ZIP
LNTOTHS	Log of number of high schools in ZIP
LNURATE	Log of county unemployment rate

Table 5: Descriptive Statistics for Army and Navy ZIP Level Semi-Log Models

Variable	Mean	Std Dev
AR_GSMA	0.4207908	1.0379504
NV GSMA	0.2851323	0.7924023
LNREC–A	-1.6572936	1.6168446
LNREC_N	-2.6810909	2.5760423
ASTATZIP	0.0614595	0.2401717
NSTATZIP	0.0533715	0.2247736
JOINTZIP	0.0435171	0.2040184
LNPOP17	4.9860697	1.6200068
LNAREA	3.5521942	1.5371486
LNDIST_A	3.2021182	1.0859471
LNDIST–N	3.4139014	1.1292344
LNPCAPIN	9.3711612	0.3671432
LNURATE	-2.9740504	0.4398697
URBAN	0.2883604	0.4530003
SUBURB	0.1434414	0.350523
HS1	0.4147123	0.4926731
HS2	0.0895562	0.2855453

Table 6: Descriptive Statistics for Army Station-Level Model

Variable	Mean	Std Dev
LNARGSMA	1.8363	0.7763
LNPOP17	8.7456	0.7651
LNAREA	6.4152	1.6009
NSTATZIP	0.6029	0.4893
LNDISTNV	1.8515	1.2695
LNAVDSTA	2.7516	0.7784
LNPRORCN	-0.4076	2.0362
URBAN	0.6424	0.4793
SUBURB	0.3456	0.4756
LNURATE	-2.9883	0.4240
LNTOTHS	2.2924	0.6061

Table 7: Descriptive Statistics for Navy Station-Level Model

Variable	Mean	Std Dev
LNNVGSMA	1.8344	0.7644
LNPOP17	9.1223	0.7319
LNAREA	6.8739	1.6519
ASTATZIP	0.7443	0.4363
LNDISTAR	1.4770	0.9814
LNAVDSTN	2.9939	0.8227
LNPRORCA	0.5279	0.9920
URBAN	0.6752	0.4683
SUBURB	0.3230	0.4676
LNURATE	-3.0157	0.4125
LNTOTHS	2.6708	0.6118

V. Model Specification and Estimation

We pool cross-sections over time to estimate the models. We specify the model in two general ways: (1) the unit of observation **is** the ZIP code level, and **(2)** the unit of observation is the recruiting station. In the first specification, the dependent variable is the number of high quality male enlistment contracts obtained from a ZIP code in a given quarter. This number will generally be small, and often zero. Hence, log-log formulations are problematic.

Our first specification of the ZIP code model is as a "level" model, with non-linearity introduced through quadratic and interaction terms. We attempt to specify the model to be flexible, with quadratic and interaction terms for the two key variables--recruiters and an indicator of whether there is a recruiting station in the ZIP code. The following is the general form of this specification:

$$E_{s,z,t} = \alpha + \beta_1 \mathrm{Rec}_{s,z,t} + \beta_2 \mathrm{Rec}^2_{s,z,t} + \beta_3 \mathrm{Rec}_{s,z,t} Pop_{z,t} + \beta_4 \mathrm{Rec}_{s,z,t} Inc_{z,t} + \beta_5 \mathrm{Rec}_{s,z,t} DStation_{s,z,t}$$

$$+ \beta_5 DStation_{s,z,t} + \beta_6 DStation_{s,z,t} Pop_{z,t} + \beta_7 Inc_{z,t} + \beta_8 Pop_{z,t} + \beta_9 Inc_{z,t} + \beta_{10} DUrban_z + \beta_{11} Suburb_{zt}$$
$$+ \beta_{12} Dist_{s,z,t} + \beta_{13} DStation_{OS,z,t} + \beta_{14} REC_{os,z,t} + \beta_{14} DHS1_{z,t} + \beta_{15} DHS2_{z,t} + \ldots + \varepsilon_{s,z,t}$$

where $E_{s,z,t}$ is enlistment contracts for services from ZIP code z at time t, "Rec" is recruiters, Pop is population, Inc is per capita income, DStation is a dummy variable equal to 1 if there is a recruiting station in the ZIP code and DUrban is a dummy variable equal to 1 if the ZIP code is in an urban area. Dist is the distance between the centroid of the ZIP code and the centroid of the station to which the **ZIP** code is assigned.[5] $DStation_{k,z,t}$ is a dummy variable indicating that

[5] If the recruiting station is in the **ZIP** code, the distance is calculated **as** the radius of a circle with the same area.

another Service's recruiting station is in the ZIP code. We also include other Services' recruiters in the equation ($Rec_{OS,z,t}$), but without the interactions that were included for the own Service recruiters. DHS1 is a dummy variable indicating that there is at least one high school in the ZIP, and DHS2 is a dummy variable indicating that there are two or more high schools in the ZIP code. One would anticipate that the Services are in competition so that, other things being equal, an increase in other Services' recruiters would reduce enlistments to the own Service.[6]

The effect of the recruiting stations location on enlistments is measured in two ways. First, a dummy variable indicating whether the Service has a recruiting station located in the ZIP code is included, along with interactions that allow the effect of the recruiting station to vary with the characteristics of its location and recruiter productivity to vary based on the existence of a station in the ZIP code. Second, the distance between the centroid of the ZIP code and the recruiting station to which it is assigned is included. This model is estimated separately for the Army and Navy using ordinary least squares.

We also specify a semi-log model of the form:

$$e^{E_{s,z,t}} = X\beta\varepsilon$$

where X is a vector of explanatory variables. It is estimated by taking natural logarithms of both sides. The quadratic and interaction terms are dropped in this specification. In both models we include dummy variables indicating Army battalions or Navy recruiting districts to which each ZIP code is assigned, and dummy variables for quarter and fiscal year. The inclusion of these

[6] In practice, we include only Army **and** Navy recruiters.

variables attempts to control for fixed effects, whether cross-sectional or over time, that may affect the estimates, and to control for omitted factors that vary over time, such as military pay and other recruiting resources. The coefficients of these variables are not reported in the tables below, but are available on request.

It is important to note that the effect of recruiting stations on enlistments may be biased in this specification. The reason is that the military may locate stations in ZIP codes from which enlistments have historically been especially productive. If so, the recruiting station indicator variable may be correlated with omitted variables affecting enlistments, biasing upward the estimated effect of stations on enlistments.

To control for this, we apply two alternative methods. The first is a fixed effects model in which each ZIP code level variable is measured as the difference from its ZIP code specific mean over the time period of the analysis. Variables that do not change over time, such as an indicator of "urban" or "suburban" location, simply drop out. But, this also means that unless there was a ***change*** in the status of a recruiting station within a ZIP code over the time period, the values for the recruiting station variable within that ZIP code are zero. Hence, this specification has the advantage that the effect of, for example, station location on enlistments is based on observations from ZIP codes in which there was a change in status over the three year period. That is, only station openings or closing during the time period will have an effect on enlistments. The disadvantage is the fixed effects specification greatly reduces the ***power*** of the test for recruiting station effects on enlistment supply. Though the pooled time series-cross section data contains in excess of 250,000 observations, openings and closings of recruiting stations are rare events within a short time series such as ours.[7] This is an important limitation to recognize because, while it is reasonable to expect that the number and location of recruiting stations will affect enlistments, it is also likely that the effect will be modest relative to resources such as recruiters or relative pay. Hence, the true effect may be positive but small in magnitude in our data.

The second general specification is as a station level model. The dependent variable is the quarterly contracts from the station's territory, i.e., those ZIP code assigned to a given recruit station. An advantage of this specification is that we do not have to use arbitrary methods to assign recruiters to ZIP codes. **A** disadvantage is that it does not permit us to estimate a recruit station location effect directly. However, the coefficient on the recruiter variable in this model provides an estimate of the effect of station size.

We specify quarterly enlistments at the recruiting station as a function of the number of own-Service recruiters assigned to the station, the number of other-Service recruiters allocated to the ZIP code in which the recruiting station resides, the characteristics of the station's territory, including area, population of 17-21 years old, and number of high schools. We also include a variable indicating whether the other Service has a recruiting station in the same ZIP code for which the own Service recruiting station is located, a variable indicating the distance from the centroid of the ZIP code in which the recruiting station is located to the centroid of the ZIP code for the nearest other Service recruiting station, and a distance variable that is the population-weighted average distance from all ZIP codes assigned to a station:

[7] DOD policies require that once a station is opened that **it** remain open for at least **3** years.

$$Dist_i = \sum ZIPpop17-21_{z,i} Dist_{z,i} / \sum ZIPpop17-21_{z,i}$$

where $Dist_i$ is the distance measure for the station and $Dist_{z,i}$ is the radial distance from ZIP code z to its assigned recruiting station i. The population weighted distance variable provides an indication of average travel distances within a station's territory. **A** decrease in the number of recruiting stations increases the average value of the variable.

We estimate the model as a log-log model of the form:

$$\ln E_{s,i,t} = \mathbf{a} + \beta_1 \ln \mathrm{Re}c_{s,i,t} + \beta_2 \mathrm{Re}c_{OS,i,t} + \beta_3 \ln Pop17-21_{i,t} + \beta_4 Area_{i,t} + B_5 DStation_{OS,i,t}$$

$$+ \beta_6 Dist_{OS,i,t} + B_7 Dist_{s,i,t} + \ldots + \varepsilon_{s,i,t}$$

VI. Results for ZIP Code Models

We present results first for the **ZIP** code level models and then the station models, for both the Army and the Navy. **ZIP** code models for the Army are presented in Table **8.** The last column (labeled "Implied elasticity") reports elasticities, at the means, for some key continuous variables. Interactions are included in the elasticity calculations.

If there are dummy variables in the interaction, they are included at the sample mean for the dummy variable in the computation. For dummy variables-- such as ASTATZIP (an Army recruiting station in the **ZIP** code)—the effect of increasing the variable from 0 to 1 is reported. Interactions with continuous variables are computed at the mean of the continuous variable, for the dummy variables.

The "own" recruiter effect implies an elasticity of about **0.42,** which is consistent with elasticities in prior studies. Note that Army recruiters are more productive in **ZIP** codes with high schools (HSREC_A), but apparently are not more productive, at the margin, in **ZIP** codes with recruiting stations **(STZREC–A).** The effect **of** Navy recruiters on Army enlistments is small, but positive and statistically significant. Taken literally, a 10% increase in Navy recruiters will result in a 0.3% increase in Army male high quality enlistments, suggesting some complementarity. ***An*** Army recruiting station in a **ZIP** code is worth about 0.26 high quality male enlistments per quarter in that **ZIP** code. (This calculation includes all interaction effects). However, a Navy station in the **ZIP** code adds about **0.45** additional high quality Army recruits. This result is counterintuitive and may be due to omitted variable bias.' If there are both Army and Navy stations in the **ZIP** the net effect is 0.18, which is less than the sum of the two independent effects (see JOINTZIP), but greater than for each individually. This provides some support for a policy encouraging collocation of recruiting stations.

Distance from each ZIP code to its assigned Army recruiting station has a negative effect on Army enlistments. Interpreted literally, a 10% increase in the average distance between the centroid of the ZIP code and its assigned recruiting station results in about a 0.3% decline in enlistments. The effect of distance from a Navy recruiting station on Army enlistments is not statistically significant. All else equal, ZIP codes with higher per capita income are associated with lower enlistments. The elasticity is –0.15. The unemployment rate elasticity is about 0.14, which is somewhat lower than is typically found in the literature (using district data).

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[8] When we estimate essentially the same model, but without interaction effects, we do obtain a larger effect for the Army station **on** Army enlistments than for the Navy station on Army enlistments.

Table 8: Army Production at the Zip Code Level

Mean dependent	0.4208
R-square	0.2607
Adjusted R-square	0.2603

Variable	Parameter Estimate	Std Error	T-stat	Implied Elasticity
INTERCEP	-0.166804	0.02756	-6.052	
PROREC_A	0.409976	0.02140	19.160	0.4190
PROREC_N	0.029811	0.01111	2.682	0.0228
PRORECA2	-0.000022803	0.00080	-0.028	
PRORECN2	-0.005061	0.00114	-4.421	
RECINC_A	-0.000002607	0.00000	-4.586	
RC_POP_A	-0.00002156	0.00000	-9.910	
STZREC–A	0.004811	0.01022	0.471	
URBREC–A	-0.146776	0.02034	-7.216	
SUBREC–A	-0.198219	0.02157	-9.191	
HSREC_A	0.036729	0.00612	6.003	
ASTATZIP	0.357391	0.10476	3.412	0.2614
NSTATZIP	0.420295	0.02425	17.332	
JOINTZIP	-0.183598	0.03276	-5.604	
STZIPOPA	-0.000115	0.00002	-6.916	
STZINC_A	-0.000030261	0.00000	-12.488	
STZPURBA	0.439719	0.09883	4.449	
STZPSUBA	0.438918	0.09931	4.420	
HSSTZ_A	0.285337	0.03233	8.825	
POP17	0.000113	0.00001	9.757	
AREA	0.000015162	0.00001	1.834	
POPDEN	-0.000229	0.00001	-17.769	
DISTAR2	-0.000294	0.00008	-3.904	-0.0287
DISTNAV	-0.000063306	0.00006	-1.060	-0.0070
PERCAPIN	-0.000005085	0.00000	-8.023	-0.1524
URATE	1.033297	0.12960	7.973	0.1378
URBAN	0.37079	0.01061	34.944	
SUBURB	0.286619	0.01127	25.440	
HS1	0.041416	0.00653	6.340	
HS2	0.343885	0.01190	28.887	
Q2	0.052063	0.00825	6.313	
Q3	0.061814	0.00758	8.156	
Q4	0.134663	0.00763	17.652	
CONTQUAR	-0.00132	0.00096	-1.371	
FY96	0.013131	0.00561	2.343	

The results for the ZIP code level Navy model are shown in Table 9. The effect of Navy recruiters on Navy enlistments, including the interaction effects, implies an elasticity of about 0.23. This is lower than generally is found in the literature, but is consistent with the 0.3 elasticity found in a recent study of Navy recruiting by Hogan, Dall and Mackin (1996). Navy recruiters are more productive in areas where there is a Navy recruiting station and where there are high schools, according to these results. Army recruiters have a positive effect on Navy enlistments, also suggesting complementarity. Though the elasticity is only slightly less than that for Navy recruiters, the marginal effect of an Army recruiter on Navy enlistments is about half of the effect of a Navy recruiter on Navy enlistments.

The effect of a Navy recruiting station in a ZIP code on Navy enlistments is substantial. Taken literally, the presence of a station increases high quality male contracts by almost 0.43 per quarter. An Army station in the ZIP code results in about 0.2 additional high quality Navy recruits per quarter. Increased distances from the centroid of the ZIP code to both Navy and Army stations have negative effects on Navy enlistments, though the larger effect for the Army distance suggests, again, omitted variable bias rather than a causal factor. Areas with greater per capita income are associated with lower Navy enlistments, all else being equal. The measured elasticity is small, about –0.08. The unemployment elasticity is also a modest -0.10.

Table 9: Navy Production at the ZIP Code Level

Mean dependent	0.2851
R-square	0.2021
Adjusted R-square	0.2016

Variable	Parameter Estimate	Std Error	T-stat	Implied Elasticity
INTERCEP	0.040472	0.0199	2.038	
PROREC_A	0.111906	0.0065	17.322	0.2185
PROREC–N	0.262039	0.0269	9.731	0.2277
PRORECA2	-0.003616	0.0005	-7.841	
PRORECN2	0.003279	0.0011	2.912	
RECINC_N	-0.000000555	0.0000	-1.055	
RC_POP_N	-0.000017844	0.0000	-8.629	
STZREC_N	0.025261	0.0099	2.564	
URBREC–N	-0.191532	0.0257	-7.459	
SUBREC_N	-0.221069	0.0266	-8.298	
HSREC_N	0.023179	0.0061	3.770	
ASTATZIP	0.205186	0.0136	15.101	
NSTATZIP	0.57453	0.2176	2.641	0.4266
JOINTZIP	-0.037247	0.0255	-1.458	
STZIPOPN	-0.000093414	0.0000	-7.459	
STZINC_N	-0.000007023	0.0000	-3.330	
STZPURBN	-0.320364	0.2141	-1.497	
STZPSUBN	-0.297348	0.2145	-1.386	
HSSTZ_N	0.227359	0.0273	8.313	
POP17	0.000086188	0.0000	9.541	
AREA	0.000002265	0.0000	0.353	
POPDEN	-0.000159	0.0000	-15.543	
DISTAR2	-0.000217	0.0001	-3.746	-0.0312
DISTNAV	-0.000069	0.0000	-1.476	-0.0113
PERCAPIN	-0.000001791	0.0000	-3.677	-0.0792
URATE	0.534403	0.0978	5.464	0.1052
URBAN	0.282241	0.0081	34.661	
SUBURB	0.171679	0.0084	20.383	
HS1	0.036677	0.0050	7.293	
HS2	0.221167	0.0092	24.040	
Q2	0.037321	0.0064	5.818	
Q3	0.032373	0.0059	5.494	
Q4	0.069122	0.0059	11.657	
CONTQUAR	-0.002791	0.0007	-3.728	
FY96	0.017946	0.0044	7.968	

In Table 10, we present the results of a semi-log model of Army enlistments at the ZIP code level. The implied Army recruiter elasticity is about **0.37,** which is comparable to the **0.42** estimate from Table **8.** The effect of Navy recruiters on Army enlistments is insignificant in this specification. We find that an Army station within the ZIP code adds about 0.55 high quality male recruits per quarter.[9] **A** Navy station in the ZIP adds about 0.34 high quality recruits per quarter, on average.

Table 10: Semi-Log Model of ZIP Code Level Army Enlistments

Mean dependent	**0.4208**
R-square	**0.2383**
Adjusted R-square	**0.2379**

Variable	Parameter Estimate	Std Error	T-stat	Implied Elasticity
INTERCEP	0.938113	0.1033	9.083	
LNREC_A	0.155047	0.0073	21.103	0.3685
LNREC_N	0.00213	0.0049	0.434	0.0051
ASTATZIP	0.552778	0.0206	26.872	1.3137
NSTATZIP	0.344707	0.0286	12.042	0.8192
JOINTZIP	-0.173713	0.0359	-4.844	-0.4128
LNPOP17	0.011814	0.0081	1.459	0.0281
LNAREA	0.031788	0.0028	11.295	0.0755
LNDIST–A	0.004932	0.0056	0.879	0.0117
LNDIST_N	-0.013053	0.0052	-2.510	-0.0310
LNPCAPIN	-0.064181	0.0094	-6.859	-0.1525
LNURATE	0.057145	0.0075	7.619	0.1358
URBAN	0.309729	0.0125	24.714	0.7361
SUBURB	0.103999	0.0101	10.330	0.2472
HS1	-0.011462	0.0065	-1.774	-0.0272
HS2	0.206838	0.0137	15.045	0.4915
Q2	0.044855	0.0085	5.303	
Q3	0.05282	0.0078	6.790	
Q4	0.12369	0.0078	15.859	
FY96	0.011306	0.0055	7.044	

[9] In a semi-log formulation, the effect of a dummy variable is simply the coefficient. Consider: $e^{E} = \mathrm{Rec}^{B} e^{CD}$. Then, $E = B \ln \mathrm{Rec} + CD$, where C is the coefficient on the dummy variable, D, which is equal to 1 or zero.

Table 11 presents the results of the semi-log ZIP code level specification for the Navy. The major anomaly in these results is that Army recruiters appear to have a larger effect on Navy enlistments than do Navy recruiters. The implied elasticity for Army recruiters is about the same as it was in Table 9. However, the measured elasticity with respect to Navy recruiters is substantially lower in this specification.

Table 11: Semi-Log Model of ZIP Code Level Navy Enlistments

Mean dependent	**0.2851**
R-square	**0.1887**
Adjusted R-square	**0.1883**

Variable	Parameter Estimate	Std Error	T-stat	Implied Elasticity
INTERCEP	0.104262	0.0801	1.301	
LNREC_A	0.061263	0.0056	10.940	0.2149
LNREC_N	0.014493	0.0039	3.736	0.0508
ASTATZIP	0.260524	0.0160	16.322	0.9137
NSTATZIP	0.282533	0.0223	12.696	0.9909
JOINTZIP	-0.060191	0.0279	-2.161	-0.2111
LNPOP17	0.037588	0.0063	5.940	0.1318
LNAREA	0.017615	0.0022	8.089	0.0618
LNDIST_A	0.008311	0.0043	1.914	0.0291
LNDIST_N	-0.02073	0.0041	-5.118	-0.0727
LNPCAPIN	0.00844	0.0072	1.176	0.0296
LNURATE	0.037155	0.0057	6.473	0.1303
URBAN	0.203553	0.0097	21.022	0.7139
SUBURB	0.038409	0.0078	4.908	0.1347
HS1	-0.004711	0.0050	-0.938	-0.0165
HS2	0.105228	0.0107	9.855	0.3690
Q2	0.028922	0.0066	4.400	
Q3	0.028556	0.0060	4.724	
Q4	0.059979	0.0061	9.897	
FY96	0.011535	0.0043	7.682	

We are concerned that the estimated effect of a recruiting station in the ZIP code on enlistments may be the result of omitted variable bias in the level models. Other variables, such as recruiters, may also be subject to bias from this source. However, in the case of recruiters, we have a significant literature from which to judge the reasonableness of the estimated effect. In the case of recruiting stations, there are no previous estimates to provide a baseline.

In Table 12, we present the results of estimating a fixed effects model for the Army. Note that the Army recruiter variable is in per capita terms and that other Service recruiters are omitted. The marginal effect of recruiters on high quality male enlistments, in this specification, is not measured with precision. However, the effect of an Army recruiting station in the ZIP code on Army enlistments is statistically significant. According to the fixed effects estimates, a station adds only about 0.1 high quality recruit per quarter to the ZIP code, a smaller effect than in the level models.

Table 12: Army ZIP Code Level Fixed Effects Model

Variable	Coefficient	T-Sta
INTERCEPT	-0.05906	-12.53
RECPPOP	12.59764	1.65
POP17	0.00002	3.52
DISTAR2	0.00013	0.76
ASTATZIP	0.10742	3.43
URATE	0.64998	3.75
HS1	0.00839	0.24
HS2	0.00430	0.09
(also time dummies and battalion dummies)		

The results of estimating recruiting station level models for the Army and for the Navy are reported in Tables 13 and 14, respectively. The models are estimated as log-log models, so that the coefficients on the continuous variables are also elasticities.

The estimated effect of recruiters on Army enlistments in this model is large. From Table 14, the Army recruiter elasticity is about 0.86, which is larger than most estimates in the literature, and larger than the ZIP code level estimates presented above (see table xx). The point estimate of the effect of Navy recruiters on Army enlistments is negative, but is estimated imprecisely. Whether there is a Navy recruiting station in the same ZIP code as the Army station (NSTATZIP) does Army enlistments. However, an increase in the area that Army recruiters must cover, as weighted by the distribution of population (LNAVDSTA), reduces enlistments, other things being equal.

Table 13: Army Recruiting Station Log-Log Model

Mean Dependent	**1.8363**
R-square	**0.5471**
Adjusted R-square	**0.5426**

Variable	Parameter Estimate	Std Error	T-stat
INTERCEP	-0.700481	0.1966	-3.563
LNREC_AR	0.86329	0.0261	33.049
LNPOP17	0.095637	0.0179	5.340
LNAREA	0.088144	0.0109	8.078
NSTATZIP	0.010195	0.0269	0.380
LNDISTNV	-0.002655	0.0125	-0.213
LNAVDSTA	-0.081793	0.0255	-3.204
LNPRORCN	-0.005508	0.0047	-1.180
URBAN	0.012159	0.0745	0.163
SUBURB	0.033526	0.0682	0.492
LNURATE	0.024967	0.0237	1.055
LNTOTHS	-0.0373	0.0203	-1.840
Q2	0.125312	0.0231	5.414
Q3	0.118494	0.0218	5.447
Q4	0.303688	0.0218	13.936
CONTQUAR	-0.001178	0.0027	-0.432
FY96	0.001417	0.0159	0.089

The results of estimating a similar station model for the Navy are presented in Table 15. Navy recruiters are also estimated to have relatively large effect on enlistments. The elasticity of 0.44 is larger than that estimated for the ZIP code level models. Army recruiters have a small, but positive and statistically significant effect on Navy enlistments. The effect is somewhat less than the effect in the ZIP code models in Table 9. In the case of the Navy, the average distance variable (LNAVDSTN) is positive, i.e., the “wrong” sign.

Table 14: Navy Recruiting Station Log-Log Model

Mean Dependent	1.8344
R-square	0.4994
Adjusted R-square	0.4939

Variable	Parameter Estimate	Std Error	T-stat
INTERCEP	-1.921146	0.3894	-4.933
LNREC_NV	0.441336	0.0240	18.378
LNPOP17	0.274531	0.0247	11.111
LNAREA	0.032593	0.0123	2.658
ASTATZIP	0.018349	0.0334	0.550
LNDISTAR	-0.013054	0.0169	-0.773
LNAVDSTN	0.072857	0.0271	2.693
LNPRORCA	0.022109	0.0102	2.165
URBAN	0.402718	0.3262	1.235
SUBURB	0.295894	0.3241	0.913
LNURATE	0.114116	0.0272	4.188
LNTOTHS	0.049236	0.0269	1.831
Q2	0.164885	0.0277	5.949
Q3	0.123253	0.0263	4.681
Q4	0.262714	0.0263	10.001
CONTQUAR	-0.012677	0.0031	-4.096
FY96	0.053274	0.0191	2.796

VIII. Summary

In this paper we estimated enlistment supply models for the Army and the Navy at the ZIP code level and at the recruiting station level. Our analysis focuses on the effects of recruiters and recruiting stations on enlistment supply, and the factors that affect the productivity of these resources at the local level. In general, we estimate own Service recruiting elasticities that are generally consistent with the literature. Our estimates indicate that other Service recruiting resources do not have a large, negative effect on a given Service's recruiting success. There is relatively robust econometric evidence that Army recruiters have a positive effect on Navy enlistments. There is also evidence that Navy recruiters have a positive influence on Army enlistments, though it is less robust.

The Service's own recruiting station appears to have a positive and statistically significant effect on the Service's enlistments in the ZIP code in which they are located. In the case of the Army, we tested whether these measured effects may be due to omitted variable bias or endogeneity of the recruit station location choice. The result--a positive and statistically significant effect-- is robust to estimation using fixed effects. For both the Army and the Navy, distance from the recruiting station appears to have a negative effect on enlistments.

In the station models, the own Service recruiter elasticity is greater than the elasticity in the ZIP code level models. This may be due to error introduced in allocating recruiters to ZIP codes in the ZIP code level models.

The results reported here provide solid evidence of the importance of both recruiters and recruiting stations on enlistment supply. Moreover, they suggest that other Service recruiters have either neutral or positive effects on enlistments. However, the point estimates of effects vary significantly with the specification. **A** focus of our research in the near term will be to evolve to a "best" specification and to better understand why the point estimates vary with the specification.

In the intermediate term, we hope to provide a richer specification by including additional data. For example, we would like to be able to characterize the recruiting station's location as a storefront or retail location, or an office location. Does distance to the Military Entrance Processing Stations (MEPS) affect enlistment supply? Finally, in the longer term, the **ZIP** code level and recruiting level approach to analyzing enlistment supply provides an opportunity to examine some interesting general questions regarding military recruiting. For example, does proximity to a military installation affect recruiting? If so, does it matter which Service is located at the installation? Do the political preferences of the local area affect military recruiting? If so, how?

REFERENCES

Bohn, Don, Edward Schmitz and Richard VanMeter, 1996. "The Geographic Location of Recruiting Resources," CNRC Report., June.

Brown, Charles., 1985. "Military Enlistments: What Can We Learn from Geographic Variation?' _American Economic Review_, vol. 75, March: 228-34.

Daula, Thomas and D. A. Smith, 1985. "Estimating Enlistment Models for the U.S. Army," in Ronald Ehrenberg (ed.), _Research in Labor Economics_, vol. 7: 261-309.

Dertouzos, J. 1985. "Recruiter Incentives and Enlistment Supply." Report R-3065-MIL, RAND Corporation: Santa Monica, CA.

Dertouzos, J. 1989. "The Effects of Military Advertising: Evidence from the Advertising Mix Test." Report N-2907-FMP, RAND Corporation: Santa Monica, CA.

Di Nardo, J. and J. Johnston, 1994, _Econometric Methods_. 4th Edition. New York, **NY:** McGraw Hill.

Goldberg, Larry, 1982. "Enlisted Supply: Past, Present, and Future," Alexandria, VA: Center for Naval Analyses, April.

Heckman, James, 1976. "The Common Structure of Statistical Models of Truncation, Sample Selection, and Limited Dependent Variables and a Simple Estimator for Such Models," _Annals of Economic and Social Measurement_, v. 5: pp. 475-92.

Hogan, Paul, Tim Dall, and Pat Mackin, 1996. **"An** Econometric Analysis of Navy Television Advertising Effectiveness," The Lewin Group.

Hotelling, Harold, 1929. "Stabiliy in Competition," _The Economic Journal_, v. XXXIX, pp. 41-57.

Kostiuk, Peter F., 1987. "Issues in Enlistment Supply," Alexandria, VA: Center for Naval Analyses, August.

Smithies, Arthur, 1941. "Optimum Location in Spatial Competition," _Journal of Political Economy_, v. XLIX, pp.423-439.

U.S. General Accounting Office, 1994. "Military Recruiting: More Innovative Approaches Needed," Washington, DC: USPGO, December.

Warner, J. T. 1989. Military Recruiting Programs in the 1980s: Their Success and Policy Issues" Unpublished manuscript, Clemson University.

Warner, J. T. 1991. "Navy Recruiting Incentive Models." Final report for Navy Personnel Research and Development Center: San Diego, CA.

Warner, John T., 1990. "Military Recruiting Programs During the 1980s: Their Success and Policy Issues," _Contemporary Policy Issues_, vol. 8, October: 47-67.

Warner, John T., and Beth J. Asch, 1995. "The Economics of Military Manpower," in Keith Hartley and Todd Sandler (eds.), _Handbook of Defense Economics_. Amsterdam: Elsevier.

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