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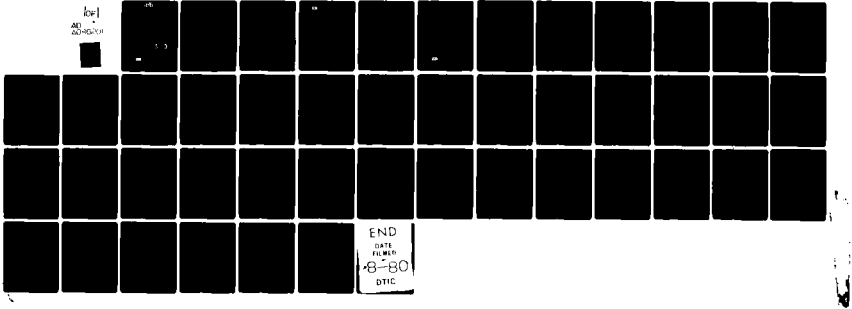

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RECRUITERS, ADVERTISING, AND NAVY ENLISTMENTS

(10) Lawrence Goldberg

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The relation between Navy enlistments by high school graduates in 1971-1977 and the number of recruiters and level of advertising expenditures is analyzed. Allowance is made for changes in economic and demographic factors and Navy goals and policies. A prediction test is made with data from 1978. Both recruiters and advertising are shown to increase enlistments, but there are important differences in their effects.

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2. This Research Contribution analyzes the effects of recruiters and advertising on Navy enlistments. To estimate these effects, the number of quarterly enlistments of high school graduates from 1971 through 1977 were related to the number of production recruiters and the stock of "awareness capital" generated by advertising expenditures in previous quarters. Differences in economic, demographic, and recruiting policies were taken into account. The results should interest those involved in long-term manpower planning and recruiting resource management.

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RECRUITERS, ADVERTISING, AND NAVY ENLISTMENTS

Lawrence Goldberg

Institute of Naval Studies

CENTER FOR NAVAL ANALYSES

2000 North Beauregard Street, Alexandria, Virginia 22311

TABLE OF CONTENTS

SUMMARY

By use of regression analysis, the present work estimates the relation between enlistments by high school graduates in 1971-77 and the number of recruiters and level of advertising expenditures. In measuring the effects of recruiters and advertising, allowance is made for changes in economic and demographic factors and Navy goals and policies. To check the model, a prediction test is undertaken with quarterly data from CY 1978.

Both recruiters and advertising increase the number of enlistments by high school graduates. However, there are important differences between the two in their effects. Unlike recruiters, advertising generates high school graduate enlistments mostly in the lower mental groups; and whereas recruiters affect enlistments in the current year, advertising's effects are felt mostly in future years. The cost of generating a high school graduate enlistment is roughly $2,200 for recruiters and $1,700 for advertising in the long run.

The variable having the greatest effect on the number of enlistments by high school graduates during the regression period is quota. Very likely quota is a proxy for eligibility standards and perhaps recruiters' efforts.

Another factor that has a sizable effect is unemployment. A one-point increase in the youth unemployment rate generates about 1,700 enlistments by high school graduates, almost 75 percent of whom would be in the upper mental groups.

INTRODUCTION

Until recently, Navy recruiting efforts were fairly successful. Between FY 1972 and FY 1977, the percent of goal achieved averaged 96.5, and usually more than 94 percent of goal was attained in any quarter (see table 1). Since the second quarter of 1977, however, only 90 percent of goal has been achieved on average and less than 94 percent in every quarter.

Navy enlistments can be broken down into two broad categories: (1) "chargeables," active duty non-prior-service males excluding reservists and (2) "others," including non-prior-service females and other male enlistees. About 70 percent of enlistments are chargeables, and high school graduate chargeables account for nearly all of the shortfall.

Starting in 1980, population declines will reduce the number of enlistments, yet the Navy's average future demand for enlistees is not expected to decline much. Therefore, the Navy is also likely to have recruiting problems in the 1980s.

Since it is likely that recruiters and advertising increase the number of enlistments, one way of reducing shortfalls might be to increase recruiting resources. There are, of course, other ways of increasing the supply of HSGs. One frequently recommended by economists is to raise military pay and benefits, but this is a costly option: higher pay must be given to the entire stock of manpower as well as to new recruits; enlistment bonuses are a more selective instrument, but they too must be paid to a large population (all enlistees).

Increases in the amount of resources devoted to recruiting may be less expensive than raising pay or giving bonuses because it eliminates extra payments to those who would volunteer anyway. Unfortunately there is little evidence on the productivity of recruiting resources, so it is difficult to estimate the cost of using more to reduce shortfalls. The present study asks how many high school graduate chargeables would be generated by additional recruiters and advertising. We answer this question by regression analysis of quarterly data for 3Q 1971 through 4Q 1977.[1] Our

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[1]The draft was still in effect during the first six quarters (3Q 1971 - 4Q 1972) of data used to measure the effects of recruiters and advertising. In reality, the services treated this as a testing period for recruiting in an all-volunteer force environment. Recruiters and advertising were sharply increased, there were few inductions, and recruiters were pressured through high goals to produce large numbers of enlistments. It seems appropriate, therefore, to measure the effects of recruiters and advertising with data from these quarters too.

TABLE 1

CHARGEABLES' QUOTAS AND PERCENT ACHIEVED, 3Q 1971 - 4Q 1978[a]

Fiscal year	Quarter	Quota (thousands)	Percent achieved Year	Quarter
1972	3Q71			
	4Q71	88.3	96.6	N.A.
	1Q72			
	2Q72			
1973	3Q72			93.4
	4Q72	99.9	91.2	103.0
	1Q73			100.6
	2Q73			71.0
1974	3Q73			96.9
	4Q73	71.2	102.9	100.2
	1Q74			93.8
	2Q74			126.8
1975	3Q74			85.0
	4Q74	81.8	94.9	101.4
	1Q75			100.8
	2Q75			102.2
1976	3Q75			98.3
	4Q75	74.0	99.2	101.3
	1Q76			102.0
	2Q76			95.7
N.A.	3Q76	28.1	N.A.	94.0
1977	4Q76			100.1
	1Q77	86.5	94.0	101.2
	2Q77			90.7
	3Q77			88.6
1978	4Q77			86.5
	1Q78	65.5	90.7	92.4
	2Q78			88.6
	3Q78			93.7
1979	4Q78	14.8	N.A.	79.1

[a]"Chargeables" are active duty non-prior-service males excluding reserves.

Source: Navy Recruiting Command, "Program Analysis."

analysis focuses on high school graduate chargeables because this group is in short supply.

There are many problems that make it difficult to estimate the productivity of recruiters and advertising with regression analysis. Perhaps the most serious one is lack of data. For example, only six annual advertising budgets are available with which to measure an effect of advertising; and the data are only slightly better for recruiters and other factors.

The variations in advertising budgets and recruiter strengths since FY 1972 make up to some degree for not having more data. The size of the recruiting force has ranged from 2,496 to 3,687. The Navy's advertising budget, in constant 1967 dollars, has varied between $5.9 and $20.8 million. Still, estimates are based on only 26 quarterly observations. Therefore our results should be viewed as tentative.

REGRESSION MODEL

QUOTAS, NAVY POLICIES, AND HIGH SCHOOL GRADUATE ENLISTMENTS

The Navy's demand for enlistees is essentially independent of the supply.[1] However, the reverse does not seem to be true; the number of high school graduates enlisted in FY 1972-78 seems to have depended on quotas. As is illustrated in figure 1, there is a strong, positive, nonlinear relationship between the two over the period. The relationship holds both for all high school graduate chargeables (HSGs) and for those in the upper mental groups (MG 1-3U). The relationship is approximated reasonably well by a quadratic function. The least squares estimates plotted in figure 1 are as follows:[2]

$$\begin{array}{lll} \text{HSGs} & = 1.04\ \text{quotas} - 0.00385(\text{quotas})^2 & R^2=0.57 \\ \text{(t-value)} & \quad (5.83) \quad\quad (1.83) & \end{array}$$

$$\begin{array}{lll} \text{MG1-3U HSGs} & = 0.77\ \text{quotas} - 0.00319(\text{quotas})^2 & R^2=0.49 \\ \text{(t-value)} & \quad (5.77) \quad\quad (2.02) & \end{array}$$

Broadly speaking, we assume that the supply of HSGs depends on the relative economic advantages of enlisting, eligibility requirements for applicants, and the amount of resources devoted to recruiting, e.g., the number of recruiters, recruiters' efforts, and advertising expenditures. The demand for HSGs depends on the Navy's overall manpower requirements.

We assume that HSG supply and demand are in balance in every quarter during the regression period. As demand for chargeables increases, there is an increase in the demand for HSG chargeables. This is met by increasing the supply of HSGs through increases in

---

[1] If quotas adjusted to supply conditions, there would be a strong, positive relationship between quotas and unemployment rates, an important factor affecting supply. Instead, the correlation between them is small and negative (-0.03).

[2] If total enlistments are used instead of annual quotas, results are essentially unchanged. Later, we will use total chargeable enlistments as a proxy for quotas because quarterly data on quotas are unavailable for FY 1972.

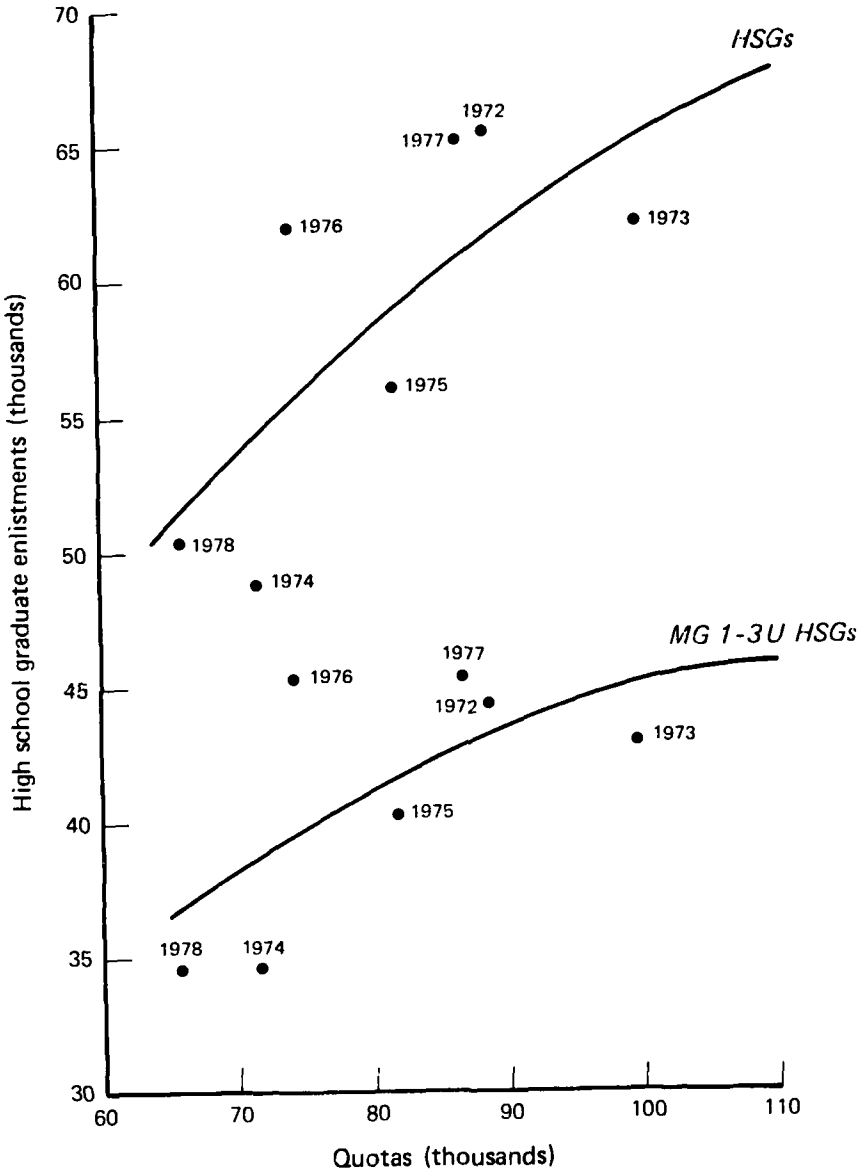

FIG. 1: QUOTAS AND HIGH SCHOOL GRADUATE ENLISTMENTS, FY 1972-78

recruiter effort and reductions in standards applying to HSGs.[1] Thus, we do not observe a given supply function in the sense that recruiter effort and standards are unchanging throughout the regression period.[2] Instead, we observe points on a shifting supply function caused by changes in these factors, and shifts are linked to the Navy's demand for enlistees. By including proxies for recruiter effort and standards, we adjust for such changes and estimate a reduced-form equation for HSG enlistments.

Efforts by Recruiters To Enlist HSGs

Because the Navy collects no systematic data on how much time recruiters spend in active search of HSGs, we will have to use a number of variables to measure the effects of this factor on supply. The desired measure -- recruiter man-years devoted to enlisting HSGs -- depends on the size of the recruiting force, their overall effort, and the percentage of time devoted to recruiting HSGs. The total number of personnel with a recruiter rating is our measure of the recruiting force. (This measure includes recruiters who are primarily administrators.[3] While we would have preferred to exclude administrators, data on the number of them are not available for the entire period.)

To adjust for differences in total effort per recruiter, we would prefer to use the exogenously determined quota. Instead we use

---

[1]During FY 1972-77, the Navy permitted standards to fall as a means of meeting enlistments goals. (For evidence on the relationship between quotas and standards, see reference 1.) We suspect that what has happened recently is that the Navy set high standards in FY 1978 and has decided to hold the line on them. Moreover, standards are probably so high that any past slack in recruiter effort has now largely disappeared. If standards are not lowered, the Navy must look to recruiters, advertising or military pay as means of reaching its enlistment goals, or other populations than chargeables as sources of manpower.

[2]Here our method is different from that taken by most previous researchers. They have assumed that recruiters' efforts and standards are unchanging.

[3]In FY 1977, about 18 percent of the recruiting force were administrators. These recruiters did not receive quotas. Administrators are all recruiters except production recruiters and recruiters in charge of stations having three or fewer recruiters.

chargeable enlistments (E) because quarterly quota data are unavailable for FY 1972.[1] Since the Navy generally makes goal during the regression period -- the shortfall averages 3.5 percent -- total chargeables is, with a few exceptions, a close approximation of the quota and, therefore, it too is exogenously determined.

Since CY 1975, all the services have been pressured by Congress and the Department of Defense to increase the quality of enlistments. The services responded by trying to enlist more HSGs and by limiting mental group 4 enlistments. This policy change may have increased recruiters' efforts to enlist HSGs. A dummy variable (NAVPL) is included to adjust for this change in HSG recruiting effort starting in CY 1975.

Standards

Since accurate data on standards are unavailable, we are again forced to use chargeable enlistments as a proxy.[2] We assume that standards for HSGs declined as the Navy increased its demand for chargeables. The supply of HSGs increased as standards were lowered, because the Navy accepted more HSGs in the lower mental groups and waived various entry requirements for them.

SUPPLY FACTORS

In addition to (1) efforts by recruiters to enlist HSGs and (2) enlistment standards, we assume that the number of high school graduate enlistments also depends on (3) the population's awareness of the Navy as a career choice, (4) the relative economic benefits of enlisting, and (5) the size of the youth population.

Population's Awareness and Advertising

Previous studies on advertising in product markets have concluded that advertising increases demand in current and future periods, but its effects decline over time (see reference 2). A study by Shucker (reference 3) shows that Navy advertising increases awareness of the Navy as a career choice. Therefore, we treat Navy advertising as an investment in a stock of intangible

---

[1]We cannot simply drop quarters in FY 1972, because there are too few observations and most of the variation in recruiters occurs that year.

[2]Another problem is that standards are multi-dimensional. Even if data were available on the many components of standards, increasing the number of variables when there are so few data points would reduce the statistical reliability of the results.

"awareness capital" whose effects last for more than one period and decline over time. We estimate the effects of awareness capital on the supply of HSGs, and given that, calculate the effect of advertising from the relationship between it and awareness capital.

Construction of a capital stock series for advertising requires that we have data on the advertising effort each quarter, as well as the base period stock and the depreciation rate of awareness capital. Only annual data are available on advertising; lacking quarterly data, we assume that the annual advertising budget is spent evenly over the fiscal year. We also assume that 250 dollars in this quarter's advertising budget (in constant 1967 dollars) generates one unit of awareness capital in the following quarter.[1]

We still face serious measurement problems because the other data are unavailable, but estimation procedures are developed to handle them. A way is found to express the base period stock as a regression parameter. This eliminates the need to know it to construct the awareness capital series. A maximum likelihood procedure was used to solve the problem of not knowing the depreciation rate. These solutions are discussed in the following section and in the one dealing with the estimation procedure.

Measurement of Awareness Capital

Let K_0 be the base period stock of awareness capital and δ its depreciation rate per quarter. In subsequent periods the net capital stock depends on K_0, δ, and the stream of advertising investments (I_t):

$$K_1 = K_0(1-\delta) + I_0$$

$$K_2 = K_0(1-\delta)^2 + I_0(1-\delta) + I_1$$

$$K_3 = K_0(1-\delta)^3 + I_0(1-\delta)^2 + I_1(1-\delta) + I_2$$

$$\vdots$$

$$K_t = K_0(1-\delta)^t + I_0(1-\delta)^{t-1} + I_1(1-\delta)^{t-2} + \ldots I_{t-1}.$$

---

[1]Advertising was adjusted for inflation by use of table A-5.

The net capital stock in any period t (except for the base period) can be written as the sum of two expressions,

$$K_t = K_0 X_t(\delta) + Y_t(\delta), \qquad (1)$$

where $X_t(\delta) = (1-\delta)^t$

$$Y_t(\delta) = I_0(1-\delta)^{t-1} + I_1(1-\delta)^{t-2} + \ldots + I_{t-1}.$$

By defining Y_0 equal to zero, equation (1) also holds in the base period.

Our method is to include both $X_t(\delta)$ and $Y_t(\delta)$ as explanatory variables in a regression model relating HSGs to supply factors. For example, given the regression model

$$\text{dependent variable} = \ldots + a*K_t + \ldots \qquad (2)$$

we substitute for K_t to yield

$$\text{dependent variable} = \ldots + a*K_0 X_t(\delta) + a*Y_t(\delta) + \ldots \qquad (3)$$

Along with K_0, $X_t(\delta)$ and $Y_t(\delta)$ measure the stock of awareness capital. The coefficient of $Y_t(\delta)$ is the effect on the dependent variable in the regression model of a one unit change in the awareness capital stock. The coefficient of $X_t(\delta)$ is equal to the coefficient of $Y_t(\delta)$ times K_0. Both variables should have a positive sign. An F-test on $X_t(\delta)$ and $Y_t(\delta)$ together is used to test whether awareness capital has a statistically significant effect on the supply of HSGs.

Relative Economic Benefits

Four factors are included to measure changes in relative economic benefits: pay, unemployment, G.I. Bill benefits, and ending of the draft.

Pay

Holding other factors constant, the ratio of military to civilian pay is expected to have a positive effect on the supply of HSGs. Theoretically, one should use discounted earnings streams. However, if we assume that long-run earnings growth rates of enlistees and civilians are roughly the same, the ratio of discounted earnings streams reduces to simply the ratio of military to civilian pay in a base period. We make this assumption and use as our measure of relative pay the ratio of expected military to expected civilian earnings during an enlistee's first term.

Civilian pay is measured by the sum of four years' full-time, before-tax earnings for a typical 18-21-year-old male worker. Similarly, military pay is measured by four years' before-tax base pay for a typical enlistee.[1] We exclude from military pay earnings in kind (quarters and subsistence allowances and their tax advantage), since they have hardly changed in real terms over the period.

Unemployment

As the unemployment rate increases, expected civilian earnings decline and it becomes more difficult and costly to find a civilian job. The unemployment rate (UNEMP) of 16-19-year-old white males is used to measure unemployment.[2] An increase in the unemployment rate is expected to increase the number of high school graduate enlistments.

G.I. Bill Benefits

Starting in January 1977, G.I. Bill benefits were reduced and the government no longer paid for all of a veteran's post-service education. Instead, for every dollar the individual pays, the government will contribute two. This change reduced the relative economic benefits of enlisting. A dummy variable starting in January 1977 (GIBL) is included as a factor. It is expected to reduce HSG enlistments and have a negative sign.

Ending of the Draft

Although the law authorizing conscription expired on 1 July 1973, for all practical purposes the draft ended in January 1973. By eliminating the risk of having to serve in the Army, ending the draft decreased the benefits of enlisting in the Navy. An all-volunteer force dummy variable starting in January 1973 (AVF) is included. It is expected to have a negative sign.

---

[1]Expected-pay series, both civilian and military, were taken from reference 10.

[2]Unemployment rates for other youth cohorts could have been used; but because they tend to move together so closely, we did not experiment with other rates. Unemployment and population data are from table A-3 in "Employment and Earnings," published by the Bureau of Labor Statistics.

Population

The eligible population (POP) is measured by the number of civilian males aged 18-24. (We could use other cohorts, such as 18-19-year-olds, but they move together almost perfectly with the 18-24-year-old group, so it would not matter statistically which one is chosen.)[1] We expect that an increase in the eligible population would increase high school graduate enlistments.

Seasonal Factors

Seasonal factors such as the ending of the school year affect the quarterly flow of HSGs. We include dummy variables for first, second, and third quarters (Q1, Q2, and Q3) to account for these factors. We expect the third quarter dummy variable, which coincides with the end of the school year, to have a positive coefficient. We have no strong expectations concerning the signs of the other seasonal dummy variables.

SPECIFICATION OF THE MODEL

As suggested by figure 1, we specify the numbers of HSGs and MG 1-3U HSGs to be nonlinear functions of total chargeable enlistments (E)[2]

$$H = E \sum_i a_i Z_i - bE^2 + cE + \varepsilon, \qquad (4)$$

where H = HSGs or MG 1-3U HSGs and the Z_i are the following factors:

Pay = Four years' military pay divided by four years' civilian pay

UNEMP = Unemployment rate of white males, 16-19 years old

POP = 18-24-year-old civilian male population

GIBL = Dummy variable (equal to one for quarters starting in 1977, zero otherwise) measuring effects of declines in G.I. Bill benefits

---

[1]The 18-19-year-old group constituted 30.9 percent ± 0.7 percent of the 18-24-year-old cohort over the period 1971-76.

[2]By using E instead of quotas we still estimate figure 1. The curves are shifted slightly to the left, however, because E was 96.5 percent of quotas during the regression period.

NAVPL = Dummy variable (equal to one for quarters starting in 1975, zero otherwise) measuring effects of a Navy policy which increased recruiters' efforts toward enlisting HSGs

AVF = Dummy variable (equal to one for quarters starting in 1973, zero otherwise) measuring effects of the ending of the draft

RECR = Number of recruiters

$X_t(\delta) = (1-\delta)^t$ for δs between 5 and 25 percent

$Y_t(\delta) = I_0(1-\delta)^{t-1}+I_1(1-\delta)^{t-2}+\ldots+I_{t-1}$ where I_t is the advertising budget adjusted for inflation in t and δs are between 5 and 25 percent

Q_1 = Dummy variable (equal to one in first calendar quarter, zero otherwise) measuring seasonality of enlistments

Q_2 = Dummy variable (equal to one in second calendar quarter, zero otherwise) measuring seasonality of enlistments

Q_3 = Dummy variable (equal to one in the third calendar quarter, zero otherwise) measuring seasonality of enlistments

c = Constant term

ε = Error term.

The model is unique in its treatment of advertising. Advertising is considered an investment in a long-lived asset, "awareness capital," which is assumed to depreciate at the rate of δ per quarter. The variables $X_t(\delta)$ and $Y_t(\delta)$ are used to measure the awareness capital stock. The effect of advertising is derived from the relationship between advertising and awareness capital, given the latter's estimated effect on HSGs.

This functional form is chosen because it is consistent with two assumptions about the underlying mechanism. The first is that the contribution of each Z_i to the number of HSG enlistments should depend on recruiter effort and HSG recruiting standards, represented by the proxy E. The equation conforms in this respect: the coefficient of Z_i is Ea_i. In terms of <u>changes</u> in H, which we may want to bring about through policy,

$$\frac{\partial H}{\partial Z_i} = Ea_i \quad .^1 \tag{5}$$

The second assumption is that the contribution of recruiter effort and eligibility standards should show decreasing returns. That is, if recruiters are already aggressive and standards are already low, further changes of this nature should exhibit diminishing returns. The equation conforms because of the negative coefficient of E:

$$\frac{\partial H}{\partial E} = \sum_i a_i Z_i - 2bE + c. \tag{6}$$

ESTIMATION PROCEDURE

It would be incorrect to apply equation (4) to the data directly. (For discussion of the data, see appendix A.) One of the assumptions of ordinary least squares regression is that the error term does not depend systematically on any of the variables. In the present case, however, the error term depends on E; this would lead us to overestimate the variances of parameters. To remove the problem, we divide equation (4) by E. (For discussion of the problem, technically called heteroscedasticity, see reference 4, pp. 259-61.)

For this reason, the regression equation to be estimated is

$$\frac{H}{E} = \sum_i a_i Z_i - bE + c + \mu, \tag{7}$$

where the error term μ equals ϵ/E.

Once the coefficients a_i are obtained, equation (5) is used to estimate the productivities of recruiters and advertising.

A search procedure is used to obtain maximum likelihood estimates. With adjustment for autocorrelation by use of the Cochrane-Orcutt technique (for discussion, see reference 4, pp. 277-84), regression models for HSGs and MG 1-3U HSGs are estimated with alternative awareness capital depreciation rates per quarter ranging from 5 to 25 percent. For both HSGs and MG 1-3U HSGs, the models

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[1]This implies constant marginal products. We test this assumption for recruiters (see appendix B).

that maximized the likelihood function[1] are those for which the depreciation rate is 11 percent. These best-fit models yield the maximum likelihood estimates of parameters including δ. (For more discussion of the estimation procedure, see reference 4, pp. 274-91 and 360-64, and reference 5.)

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[1]To derive the likelihood function, it is assumed that, after adjustment for autocorrelation, error terms of the regression model given by equation (7) are independent and normally distributed, having a zero mean and constant variance in each quarter.

RESULTS

REGRESSION FINDINGS

Maximum likelihood estimates and their t-values are reported in table 2. A number of factors have statistically significant effects on HSG and MG 1-3U HSG enlistments. For all HSGs, chargeables and the third quarter dummy variable are significant at the one percent level. The unemployment rate, the number of recruiters, and awareness capital, i.e., X(11) and Y(11) together, are significant at the five percent level. Population, GIBL, and NAVPL are significant at the ten percent level. Pay, AVF, Q_1, and Q_2 are not statistically significant. The results for MG 1-3U HSGs are similar to those for all HSGs.

The high $\bar{R}^2$s indicate that the models explain most of the variation in the dependent variables. According to the F-statistics, the models are statistically significant at the one percent level. The t-statistics for Rho suggest that adjustments for autocorrelation are perhaps necessary only in the regression model for all HSGs.

Although awareness capital is statistically significant, its effect measured by the coefficient of Y(11) is imprecise.[1] This may be caused by high collinearity between X(11) and Y(11) (the simple correlation coefficient of -0.95; see appendix A).

Except for GIBL, all variables have the expected sign. The effect is positive for pay, unemployment, population, NAVPL, recruiters, X(11), Y(11) and Q_3, and negative for chargeables and AVF.[2]

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[1]Imprecise estimates of X(11) and Y(11) may explain a peculiar result obtained for the estimate of the base period capital stock (K_o). It is calculated by the ratio of X(11) and Y(11) coefficients. For HSGs the estimate of K_o is about 870 thousand units of awareness capital. Although the estimate is positive, as expected, it seems too high. Given a depreciation rate of 11 percent per quarter, to obtain such a high steady- state level would require advertising to be about $24 million per year. Prior to FY 1972, however, advertising was at much lower levels. Since we use the ratio of imprecise estimates to calculate K_o, its estimate is also likely to be imprecise. Perhaps this explains the high estimate of K_o obtained.

[2]The sign of AVF changes direction for MG 1-3Us, but it is not statistically significant in either model.

TABLE 2

REGRESSION FINDINGS

Independent variables	% HSG	t	% MG 1-3U	t
Constant	-7.99	-1.60[a]	-3.62	-0.90
Pay	0.655	1.29	0.120	0.28
UNEMP	0.0299	2.64[b]	0.0219	2.02[b]
POP	0.000515	1.63[a]	0.000217	0.84
E	-0.0000108	2.94[c]	-0.0000105	3.30[c]
RECR	0.000244	2.34[b]	0.000215	2.50[b]
X(11)	2.01	1.99[b]	1.18	1.44[a]
Y(11)	0.00000231	1.32[d]	0.000000852	0.58[d]
GIBL	0.0453	1.57[a]	0.00306	0.10
NAVPL	0.0972	1.68[a]	0.153	2.92[c]
AVF	-0.0430	-0.54	0.0273	0.38
Q_1	-0.0307	-1.26	-0.0180	-1.02
Q_2	0.0305	1.56	-0.0144	0.10
Q_3	0.157	3.10[c]	0.105	2.52[b]
$\bar{R}^2$	0.899	N.A.	0.905	N.A.
$F_{(13,11)}$	17.4[c]	N.A.	18.6[c]	N.A.
D-W	2.63	N.A.	2.15	N.A.
Rho	-0.469	2.65[b]	-0.191	-0.97

[a]Statistically significant at ten percent level.

[b]Statistically significant at five percent level.

[c]Statistically significant at one percent level.

[d]F-test of X(11) and Y(11) together indicates statistical significance at five percent level for HSGs and ten percent level for MG 1-3U HSGs.

The unexpected sign for GIBL is probably caused by the fact that a relatively large number of HSG contracts were signed just prior to reduction of G.I. Bill benefits in the first quarter of CY 1977. This caused a spillover of enlistments in 1977, which would tend to reverse the sign for the G.I. Bill quarters -- 1Q 1977 - 4Q 1977.

Tests of the Model

In measuring the effects of recruiters and advertising, we assume that advertising operates through a stock of awareness capital having an 11 percent depreciation rate, and that recruiters have an immediate, constant marginal effect. We also estimated the model with other treatments of recruiters and advertising, which yielded evidence supporting our method and findings.

Treating advertising as a stock rather than a flow improves the fit of equation (7). Changing the depreciation rate reinforces the finding that the effect of advertising is measured imprecisely. Only current recruiters seem to be important, and their marginal productivity appears to be constant over the range of recruiting force levels observed. (For details, see appendix B.)

To check the stability of the model, we predicted the number of HSGs in CY 1978 with actual levels of explanatory variables. Predictions are given in table 3. The model does well: it predicts the sharp decline in HSGs with only a 2.1 percent error for the year. These results increase our confidence in the model and the implied estimates of marginal products.

TABLE 3

HSG PREDICTIONS FOR CY 1978

Quarter	Predictions	Actuals	Predictions - actuals	Percent errors
1	9,950	9,880	70	0.7
2	10,440	10,989	-549	-5.0
3	17,731	18,344	-613	-3.3
4	9,631	9,571	60	0.6
Year	47,752	48,784	-1,032	-2.1

MARGINAL PRODUCTS

Marginal products (MPs) and elasticities for CY 1978 are given in table 4. For all variables except E, MPs are calculated by use of equation (5a):

$$MP_i = a_i(\text{enlistments in CY 1978}) \quad .^1 \qquad (5a)$$

The MP of a supply factor depends on its regression coefficient and enlistments in CY 1978, the proxy for standards and recruiters' efforts in CY 1978.

The MP of the variable E is given by equation (6a):

$$MP_E = \sum a_i Z_{i,1978} - 2bE_{Q,1978}, \qquad (6a)$$

where $E_{Q,1978}$ = enlistments in a typical quarter.

During the regression period, an increase in the quota was associated with a reduction in standards and, perhaps, an increase in recruiters' efforts. Thus, the MP of E gives the effect in CY 1978 of reducing standards and increasing recruiters' efforts, if we assume that the past relationship between these factors and E remains unchanged.

Recruiters

An additional recruiter would yield on the average 14.0 HSGs of which 12.3 would be MG 1-3Us. Thus, most of the recruiters' effect is on HSGs in the upper mental groups. These recruits are generated immediately, as we concluded from our experiments with other models including lagged recruiters (see appendix B).

For HSGs, the elasticity of recruiters is 0.98 if we include all, but if we exclude administrators, it is only 0.80. The lower elasticity is probably more accurate. During the regression period, most of the variation in the number of recruiters occurs between FY 1972 and FY 1974, when about 1,200 were added. The regression model yields an estimate for the type of recruiter added during the regression period. We suspect that few of those added were administrators.

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[1]There is an implicit assumption that the relationship between enlistee shipments and contracts over a fiscal year is unchanging. This was essentially true during most of the regression period: the number of contracts signed and enlistees shipped were roughly the same (20,000 per quarter) over 3Q 1971 - 4Q 1977. However, if the relationship significantly changes, it might be better to use contracts instead of enlistments to estimate marginal products.

TABLE 4

EFFECTS OF FACTORS IN CY 1978[a]

Factor	1978 Level[a]	All HSGs (48,784) MP	All HSGs (48,784) Elasticity	MG 1-3U HSGs (33,173)[b] MP	MG 1-3U HSGs (33,173)[b] Elasticity
One recruiter					
All	3425	14.0	0.98	12.3	1.27
Except administrators	2808	14.0	0.80	12.3	1.04
$1 million of advertising	$10M	1206	0.25	445	0.14
One percentage point of ratio of relative pay	0.62	376	0.48	69	0.13
One percentage point of rate of unemployment	13.5	1717	0.48	1258	0.51
Each 1000 of population	13.4M	29.6	8.13	12.5	5.05
One chargeable	54,431	0.69	0.81	0.43	.74

[a]Used to calculate elasticities.

[b]Estimated from ratio of MG 1-3U HSGs to all HSGs in first three quarters of CY 1978, i.e. 0.68.

Previous estimates of the recruiter's elasticity[1] are between 40 and 75 percent (see references 6, 7, 8, and 9). However, most were obtained with (at least some) cross-sectional data from FY 1974 and FY 1975. In those years, enlistment quotas were low and factors associated with low quotas may have reduced the recruiters' productivity (see reference 9).

Advertising

A once-and-for-all increase in advertising of $1 million would yield 1,206 HSGs in the long run. Only 445, or 37 percent, would be in the upper mental groups, however. (For details on how the productivity of advertising is calculated, see appendix C.)

The effects of advertising are felt mostly in the future. With an estimated depreciation rate of 11 percent per quarter, we calculate that only 30 percent of the total effect is felt in the current year; it takes four years for 83 percent to accrue (see table C-1).

Comparison of Recruiters and Advertising

Thus, both recruiters and advertising affect the supply of HSGs, but the effects differ in two important respects which make advertising less attractive: unlike recruiters, advertising largely affects HSGs in the lower mental groups; and, rather than this year, most of its effects are felt in the future.

Pay

If pay increased by one percentage point, it would yield only 376 HSGs of which 69 would be in the upper mental groups. The elasticities of 0.48 (for HSGs) and 0.13 (for MG 1-3U HSGs) seem low, but similar to those found in recent studies by the Urban Institute (reference 10) and Rand.

This result is probably due to there having been little independent variation in pay: most of the variation consisted of a slight decline toward the end of the regression period when the Navy put greater emphasis on recruiting HSGs. Thus the negative effects of relatively small declines in pay were probably overwhelmed by the positive effects of changes in other variables, e.g., recruiting effort. (For evidence, see "Multicollinearity and the Effect of Population" below.)

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[1]The elasticity is the percentage change in enlistments for a percentage change in a factor such as recruiters.

Unemployment

A one-percentage-point increase in the youth unemployment rate would yield 1,717 HSGs and 1,258 (73 percent) would be in the upper mental groups. The elasticities are 0.48 for HSGs and 0.51 for MG 1-3U HSGs.

Population

The estimates of population's effects are imprecise and too large. If population increases by 1,000, HSG enlistments increase by 29.6 $\pm$ 18.2 and MG 1-3U HSG enlistments by 12.5 $\pm$ 14.8. Currently the HSG enlistment rate is about 3.4 per thousand. It does not seem reasonable that the enlistment rate for new entrants to the population pool would be almost nine times larger than it is for the 1978 cohort.

The results may be due to a number of factors. First, population may be correlated with omitted variables: for example, while population increased, attitudes toward the military improved as Vietnam became a distant memory. Second, several variables exhibit strong trends, especially pay and population. This multicollinearity reduces the precision of regression estimates, and may be enlarging the coefficients and standard errors estimated for population.

Multicollinearity and the Effect of Population

Given these findings for population, one cannot help wondering whether omitted variables and multicollinearity affected our estimates of the MPs of other variables, especially recruiters and advertising. According to Wallace (reference 11), when there are few observations and a great deal of collinearity among explanatory variables, it is useful to employ "true restrictions" in the estimation procedure. True restrictions greatly reduce the mean square error of all the fitted coefficients.

Wallace's method, Restricted Least Squares (RLS), was also used to estimate the model in which X(11) and Y(11) measure awareness capital. This was done by restricting the population variable's coefficient to imply an HSG enlistment rate of 3.4, which is likely to be much closer to the true value than what was obtained.

There is little change in the effects of most variables when the model is estimated by use of RLS. Chargeables, recruiters, unemployment, and awareness capital remain statistically significant, and their magnitudes change by less than 10 percent. However, pay and NAVPL, variables correlated to each other and population (see

table A-4), are affected.[1] Pay's coefficient declines to almost zero and NAVPL's increases by almost 50 percent. The RLS results suggest that pay and population may be poorly measured because of collinearity with NAVPL, but this does not seem to be a problem for recruiters and advertising.

Standards and Recruiters' Efforts

A change in E has a large effect on the supply of HSGs: if E increased by 1,000, there would be an increase of 690 HSGs of which 430 would be MG 1-3Us. There were large changes in E during the regression period. Therefore, assuming that E measures standards and recruiters' efforts, we conclude that those factors were probably the most important ones affecting the supply of HSGs during the regression period.[2]

Given current shortfalls, it is unlikely that recruiters' efforts could be increased significantly above the CY 1978 level. In CY 1978, increases in HSGs would have had to be generated by reductions in standards alone. To the extent that past changes in E increased recruiters' efforts, the MP calculated for E is too large.

More important than a hypothetical effect is the fact that we really do not know how standards are used to affect the supply of HSGs. Since the results suggest that standards were (and continue to be) an important policy tool, more research on the effects of standards would be worthwhile.

RECRUITER AND ADVERTISING COST PER HIGH SCHOOL GRADUATE

Given MPs and estimates of recruiting resource costs, we calculate the cost of recruiters and advertising per high school graduate enlistment. These are given in table 5. As was pointed out earlier, a $1 million increase in advertising in 1967 dollars would yield 1,206 HSGs in the long run. In CY 1978 it would take $2.02 million of advertising to produce what $1 million could buy in 1967. The ratio of $2.02 million to 1,206 HSGs, or $1,675, is advertising's cost per HSG. The cost per MG 1-3U HSG is $4,539.

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[1]Surprisingly, the coefficient of X(11), which is highly correlated to population, does not change much.

[2]The results for NAVPL also indicate that changes in recruiters' efforts have strongly affected the supply of HSGs.

TABLE 5

COST PER HSG OF RECRUITERS AND ADVERTISING IN CY 1978

Group	$1 million advertising: Cumulative marginal productivity (1978-84)	$1 million advertising: Marginal cost[a] (millions)	$1 million advertising: Cost per HSG	One recruiter: Marginal productivity (1978)	One recruiter: Marginal cost[b]	One recruiter: Cost per HSG
All HSGs	1,206	2.02	$1,675	14.0	$30,200	$2,157
MG 1-3U HSGs	445	2.02	$4,539	12.3	$30,200	$2,455

[a]The marginal cost of $1 million of advertising equals the advertising price index times $1 million. The price index is 2.02 in 1978 (table A-5).

[b]Marginal cost includes: $18,500 for recruiter's salary, allowances, retirement, training, reenlistment bonus, and special pay; and $11,700 for support costs including salaries and operations and maintenance expenses. (Navy Recruiting Command)

The cost of an additional recruiter is about $30,200 in CY 1978. Given a marginal productivity of 14.0 HSGs, the cost per HSG for recruiters is $2,157. The cost per MG 1-3U HSG is $2,455.

Although the cost per HSG is lower for advertising in the long run, it is more costly than recruiters in the short run. This is because only 30 percent of the HSGs generated by advertising accrue in the first year. As a result, the cost per HSG generated in the first year is about two and one-half times higher than recruiters'. To calculate it, we divide HSGs generated by advertising in the first year (356) by $2.02 million to yield a cost of $5,674 per HSG.

For MG 1-3U HSGs it is less costly to use recruiters in the long or short run.

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APPENDIX A

DATA

APPENDIX A

DATA

For an overview of the data, table A-1 gives HSGs and supply factors by fiscal year for FY 1972-78. There were relatively large increases and then declines (except for FY 1977) in HSGs and total chargeable enlistments. The unemployment rate declined, increased, and then declined again. Relative pay changed little, trending downward for the most part. The 18-24-year-old male population, on the other hand, trended upward and increased modestly over the period. The number of recruiters increased sharply (as did advertising and relative pay) and then remained fairly constant. Advertising increased initially, remained constant for three years, and then declined to half the previous level for the rest of the period. While our data are not perfect, they probably do reflect the kinds of changes that occurred in HSGs and supply factors during the regression period.

Table A-2 gives the quarterly data used to estimate the model. Dummy variables are not given because values can be derived easily from their definitions. Observations from the third quarter of 1971 through the fourth quarter of 1977 are used to estimate the models. The four quarters of 1978 are used in predicting HSGs in CY 1978.

The Navy Recruiting Command (NRC) collects data on HSGs and chargeables, but not on MG 1-3U HSGs. The Defense Manpower Data Center (DMDC) collects data on MG 1-3U HSGs, but its data on enlistments sometimes includes reservists as well as chargeables. To estimate MG 1-3U HSGs we multiply two percentages: MG 1-3U HSG per HSG (from DMDC) and HSG per chargeable (from NRC).

Tables A-3 and A-4 give the means, standard deviations, and correlations of variables. Table A-5 contains the annual composite media cost index that was used to adjust the advertising budget for inflation.

TABLE A-1

CHARGEABLE ENLISTMENTS AND SUPPLY FACTORS BY FISCAL YEAR

Fiscal year	Chargeable enlistments (thousands)	HSGs (thousands)		Percent of unemployment	Ratio of military to civilian pay	Population (millions)	Number of recruiters	Advertising[a] (1967 $millions)
		All	MG 1-3U					
1972	85.3	65.6	44.8	14.8	0.66	11.1	2496	5.9
1973	91.1	62.4	43.0	13.5	0.71	11.7	3404	18.3
1974	73.3	49.0	34.8	12.8	0.70	12.1	3620	20.8
1975	77.6	55.9	40.2	15.3	0.70	12.3	3687	18.0
1976	73.4	62.0	45.4	18.0	0.68	12.7	3325	10.7
1977	81.3	65.0	45.1	15.9	0.62	13.2	3492	9.7
1978	59.4	50.4	34.5	13.8	0.60	13.3	3425	9.85

[a]Adjusted for inflation by means of table A-5.

TABLE A-2

QUARTERLY DATA

Year	Quarter	Chargeables	HSGs per chargeable	MG 1-3U HSGs per chargeable	Unemployment rate (percent)	Relative pay	Population (thousands)	Number of recruiters	Advertising (1967 $ millions)
1971	3	27103	.84	.5880	15.1	0.542354	10915	2415	5.9
	4	18951	.80	.5760	14.9	0.650513	11092	2415	5.9
1972	1	18409	.77	.5313	14.7	0.745962	11243	2576	5.9
	2	21822	.62	.3720	14.5	0.727793	11393	2576	5.9
	3	40245	.66	.4092	14.2	0.710744	11544	3169	18.3
	4	20404	.67	.4690	13.8	0.695102	11694	3169	18.3
1973	1	14006	.74	.5994	13.3	0.725604	11802	3639	18.3
	2	16166	.73	.5329	12.8	0.709521	11910	3639	18.3
	3	25007	.74	.5180	12.3	0.694129	12018	3620	20.8
	4	12157	.67	.5025	12.6	0.721176	12126	3620	20.8
1974	1	17314	.61	.4453	12.9	0.706139	12173	3620	20.8
	2	17928	.66	.4488	13.2	0.694412	12220	3620	20.8
	3	26828	.67	.4489	13.5	0.683198	12267	3687	18.0
	4	20287	.61	.4209	14.7	0.709857	12313	3687	18.0
1975	1	12911	.81	.6642	15.9	0.699168	12417	3687	18.0
	2	17362	.87	.6351	17.1	0.694417	12520	3687	18.0
	3	24838	.88	.6336	18.3	0.694747	12624	3325	10.7
	4	16427	.86	.6450	18.1	0.690089	12727	3325	10.7
1976	1	15888	.76	.5776	17.8	0.685466	12802	3325	10.7
	2	16263	.86	.6106	17.6	0.659754	12876	3325	10.7
	3	26455	.83	.5976	17.3	0.636573	12951	3448	10.2
	4	18768	.79	.5688	16.8	0.637174	13025	3492	9.7
1977	1	17324	.78	.5538	16.2	0.616256	13074	3492	9.7
	2	16253	.83	.5561	15.6	0.609083	13122	3492	9.7
	3	28959	.80	.5440	15.0	0.600402	13170	3492	9.7
	4	13618	.82	.5822	14.2	0.629918	13218	3425	9.85
1978	1	11606	.851	.60421	15.9	0.625	13287	3425	9.85
	2	12938	.849	.56034	12.3	0.620	13342	3425	9.85
	3	21195	.866	.58022	11.9	0.615	13383	3425	9.85
	4	11692	.819	N.A.	14.0	0.610	13424	3425	9.137

TABLE A-3

MEANS AND STANDARD DEVIATIONS

Variables	Mean	Standard deviation
HSGs as % of chargeables	0.757	0.084
MG 1-3U HSGs as % of chargeables	0.540	0.078
Chargeables	20065	6115
Pay	0.676	0.047
Recruiters	3345	393
Population	12278	666
Unemployment	15.1	1.80
X(11)	0.333	0.272
Y(11)	87032	44543
AVF	0.77	0.42
GIBL	0.15	0.36
NAVPL	0.46	0.50
Q_1	0.23	0.42
Q_2	0.23	0.42
Q_3	0.27	0.44

TABLE A-4

CORRELATIONS

Variables	% HSGs	% MG 1-3U HSGs	E	Pay	R	POP	U	X(11)	Y(11)	AVF	GIBL	NAVPL	Q_1	Q_2	Q_3
% HSG	1	N.A.	-0.13	-0.51	-0.10	0.38	0.71	-0.27	0.29	0.20	0.26	0.74	-0.08	0.03	0.12
% MG1-3U HSG	N.A.	1	-0.36	-0.33	0.07	0.37	0.63	-0.31	0.36	0.34	0.11	0.69	0.16	-0.10	-0.04
Chargeables			1	-0.18	-0.24	-0.23	-0.03	0.26	-0.29	-0.40	-0.07	-0.20	-0.37	-0.22	0.84
Pay				1	0.17	-0.31	-0.29	0.14	-0.08	-0.04	-0.56	-0.42	0.24	0.08	-0.31
Recruiters					1	0.65	-0.10	-0.78	0.76	0.87	0.16	0.28	0.06	0.06	-0.07
Population						1	0.48	-0.97	0.88	0.79	0.55	0.83	-0.02	0.06	-0.06
UNEMP							1	-0.42	0.47	0.17	0.04	0.80	0.01	0.01	0.00
X(11)								1	-0.95	-0.87	-0.42	-0.75	0.00	-0.08	0.08
Y(11)									1	0.89	0.22	0.71	0.01	0.06	-0.06
AVF										1	0.23	0.51	0.08	0.08	-0.08
GIBL											1	0.46	0.02	0.02	-0.02
NAVPL												1	0.04	0.04	-0.04
Q_1													1	-0.30	-0.33
Q_2														1	-0.33
Q_3															1

TABLE A-5

COMPOSITE MEDIA COST INDEX
(1967 = 100)

Year	Index
1960	78
1961	81
1962	83
1963	86
1964	88
1965	91
1966	97
1967	100
1968	104
1969	109
1970	111
1971	113
1972	120
1973	126
1974	136
1975	149
1976	168
1977	185
1978(est.)	202

Constructed by the McCann-Erickson Advertising Agency, 1 Sep 1978

APPENDIX B

SENSITIVITY ANALYSIS FOR HSG MODEL

APPENDIX B

SENSITIVITY ANALYSIS FOR HSG MODEL

The results reported in table 2 depend on various assumptions: a depreciation rate for awareness capital of 11 percent; a constant, immediate effect of adding recruiters; and a delayed, declining effect of advertising over time. The sensitivity of our findings to these assumptions is tested for the HSG model.

Alternative Depreciation Rates

Values of the log likelihood function can be used to construct a confidence interval for δ (reference 4, pp. 43-44).

The statistic $-2\log\lambda$ has a χ^2 distribution with one degree of freedom, where

$$\lambda = \frac{\text{likelihood function } (\delta)}{\text{likelihood function } (\delta=11)} .$$

The 90-percent confidence interval includes values of δ above and below 11 percent for which $-2\log\lambda$ is less than or equal to 2.71. We find $9 \leq \delta \leq 14$ is a 90-percent confidence interval for δ.[1]

We find that recruiters and advertising are statistically significant at the five percent level for all values of δ chosen within the 90-percent confidence interval. We also find that the coefficient of recruiters is fairly insensitive to the value of δ: it changes by less than 20 percent over the range $9 \leq \delta \leq 14$. This increases our confidence in the estimate of the recruiter coefficient given in table 2.

While always positive, the coefficients of X and Y are more sensitive. For example, if δ is 14 the coefficient of Y declines by 70 percent, but it increases by 8 percent at δ equal 9. Thus, we have further evidence that while advertising's effect is statistically significant, it is subject to a great deal of uncertainty.

Alternative Treatments of Recruiters and Advertising

We assume that current recruiters and a weighted sum of current and lagged advertising implied by X(11) and Y(11) affect the supply of HSGs. To test for possible specification errors, we try other models which vary in their treatment of recruiters and advertising.

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[1] Results are similar for MG 1-3U HSGs.

Instead of just current recruiters, we also include lagged recruiters in equation (7). We find recruiters lagged one or two quarters are not statistically significant. Furthermore, the magnitude and significance of current recruiters and other variables are unaffected by inclusion of lagged recruiters. It appears, therefore, that only current recruiters are important.

When current and lagged advertising flows are used instead of X(11) and Y(11), we find poorer fits (lower R^2).

Two models were estimated to test whether there is a constant recruiter marginal productivity.[1] We include current recruiters squared, and the logarithm of recruiters instead of the actual level. Squared recruiters is not statistically significant, and it has no effect on either the overall fit or the recruiter effect. Using the logarithm of current recruiters results in a poorer fit and a similar recruiter elasticity. While we have no doubt that after some point there are diminishing returns to recruiters, the results seem to support the assumption of a constant recruiter marginal productivity within the range of the data observed, that is, a recruiting force of 3,687 (in 1978 it was 3,425) and an advertising budget of $20.8 million in constant 1967 dollars (in 1978 it was $9.8 million).

In summary, treating advertising as a stock rather than a flow yields a better fit. Only current recruiters appear to be important, and their marginal productivity appears to be constant over the range observed.

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[1]Because of the complicated and time-consuming estimation procedure required, we do not attempt to estimate models permitting nonlinear relationships between awareness capital and HSGs.

APPENDIX C

CALCULATION OF THE PRODUCTIVITY OF ADVERTISING

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Advertising is assumed to generate "awareness capital" which affects the supply of HSGs. We have used regression analysis to estimate the effect and depreciation rate of awareness capital. Here we explain how these estimates are used to calculate the productivity of advertising in CY 1978.

We assume that a $250 thousand expenditure made this quarter yields 1,000 units of awareness capital next quarter. Thus a $1 million increase in the Navy's annual advertising budget is assumed to yield 4,000 units of awareness capital.

In estimating the effect of awareness capital, we assumed that a $1 million increase in the advertising budget is spent evenly throughout the year. This assumption was made because we have no data on the distribution of advertising expenditures within fiscal years.

However, for calculation of the productivity of advertising it is convenient to assume that, instead of being evenly distributed throughout the year, an increase in funds would be spent during the first quarter. In this way the 4,000 units of awareness capital generated by a $1 million increase in advertising are added at the beginning of the second quarter rather than throughout the year.[1] Given these 4,000 units depreciate by 11 percent per quarter, there would be 3,560 units in the third quarter, i.e., 4,000 x 0.89, 3,168 units in the fourth quarter, i.e., 4,000 x $(0.89)^2$, and so on.

The 4,000 units in the second quarter yield 133 HSGs. This is calculated as follows:

$$H \text{ in second quarter} = (\Delta \text{Capital})(\text{Coefficient Y(11)} \times (E_{1978} \text{ per quarter})$$

$$133 = (4000)(0.00000231)(57431 \div 4)$$

With the 11 percent depreciation rate, 133 times 0.89 HSGs are generated in the third quarter, 133 times $(0.89)^2$ in the fourth quarter, and so on. Thus 356 HSGs are generated the first year, 317 the second year, etc. (see table C-1).

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[1] If, instead, funds are spent evenly throughout the year, we would calculate the same long-run effect but the first year's effect would be about half as large.

TABLE C-1

ANNUAL AND CUMULATIVE EFFECTS OF
$1 MILLION INCREASE IN ADVERTISING IN CY 1978[a]

Effect and cohort	Year 1 (1978)	Year 2 (1979)	Year 3 (1980)	Year 4 (1981)	Later years (1982-84)
All HSGs					
Annual	356	317	199	125	209
Cumulative	356	673	872	997	1206
MG 1-3U HSGs					
Annual	131	117	73	46	78
Cumulative	131	248	321	367	445
Annual as percent of long-run	29.5	26.3	16.5	10.4	17.3
Cumulative as percent of long-run	29.5	55.8	72.3	82.7	100

[a]Advertising measured in constant 1967 dollars.

In general, the long-run effect of a once-and-for-all increase in the Navy's advertising budget (and the steady-state effect of a permanent increase) is given by

$$\Delta H = (4\Delta A)(0.00000231)(E \div 4) \sum_{t=1}^{\infty} (1-\delta)^{t-1} , \qquad (C-1)$$

where

t=1 = the first quarter after the advertising expenditure is made
E = the number of chargeables per year
δ = the depreciation rate of awareness capital
ΔA = the increase in advertising in thousands of 1967 dollars.

Equation (C-1) adds up the effects on HSGs over time to yield the long-term effect. The last expression, $\sum_{t=1}^{\infty} (1-\delta)^{t-1}$, can be reduced to $1/\delta$. Evaluating equation (C-1) in CY 1978 for HSGs and MG 1-3U HSGs yields

HSG = 1.206 A
MG 1-3U HSG = 0.445 A

Thus a $1 million increase in advertising yields in the long run 1,206 HSGs and 445 of these are MG 1-3Us.