

## **AN ANALYSIS OF FIRM MOTIVATION IN THE DEFENSE INDUSTRY**

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### **ABSTRACT**

This article considers the performance of firms in the defense industry. The analysis suggests that in terms of profitability and revenue there is no advantage to be gained by a firm from increasing the proportion of its total sales which go to the military. As a corollary to this proposition we find that the firms examined are profit maximizers and are not content to simply maximize revenues. Another conclusion to be drawn from the empirical analysis is that there is a difference between high and low defense commitment firms and that this distinction occurs when the percentage of sales to the government reaches the seventeen percent level.

### **I. Introduction**

Concern for the structure and performance of the defense industry is certainly not new. Investigations have been undertaken by Adams (1968), Peck and Scherer (1970), Scherer (1964), and Weidenbaum (1968 and 1974). More recently the work of Gansler (1980) has added significantly to an understanding of the United States defense industry.

Several researchers have focused specifically on defense industry profit performance. Agapos and Galloway (1970) examined aerospace industry profits during wartime and found no evidence of excessive profits. The Comptroller General (1971) and Bohi (1973) reported little or no difference between the profit rates for defense firms and their non-defense counter parts. Weidenbaum (1968) found that defense industry profits were unusually high while a Logistics Management Institute study (1970) found that the defense industry profits were too high during the 1950s and too low during the 1960s. The Department of Defense (1976) found that profits when measured against sales were lower for defense contractors but higher if measured against investment.

This study is also concerned with profit performance in the defense industry. It is distinguished from these prior studies in several respects. First, a broader definition of the defense industry is employed. Second, the analysis is updated to cover the years 1975 through 1979. Third, and most important, all of the prior studies assume that profits are the objective of business firms while the current analysis does not make such a presumption. Rather, it seeks to determine the impact of defense sales at the firm level on total revenues as well as profits.

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## II. Model Specification

### 1. The Specification of the Dependent Variables

One approach to defense industry analysis which may help bring the profit picture into clearer focus is to control in a more systematic fashion for confounding variables that in themselves result in differences between defense and non-defense industry profits. To some extent the use of profit ratios instead of profit levels may be viewed as an approach to control for at least one major variable by dividing profits by that variable. For example, this is the case when profitability is measured as return on investment. Alternatively, a profit level equation may control for this major variable by treating it as an explanatory variable.

To determine the implications of these two approaches, consider the following two equations.

$$(1) \quad (Y(i)/X(i)) = A1 + A2 Z(i) + e(i)$$

where:  $Y(i)$  = profits for the  $i$ th firm;  
 $X(i)$  = net plant for the  $i$ th firm;  
 $Z(i)$  = all other control variables for the  $i$ th firm;  
 $A1$  = constant term;  
 $A2$  = partial regression coefficient; and  
 $e(i)$  = error term.

$$(2) \quad Y(i) = B1 + B2 X(i) + B3 Z(i) + e(i)$$

where:  $B1$  = constant term and  
 $B2$  and  $B3$  = partial regression coefficients for additional control variables.

The first equation treats profits as a ratio of the profit level to a control variable such as net plant. The second equation treats profits as a level variable but would control for net plant by making it an explanatory variable. The corresponding expected values are given by the equations:

$$(3) \quad E(Y(i)/X(i)) = A1 + A2 Z(i)$$

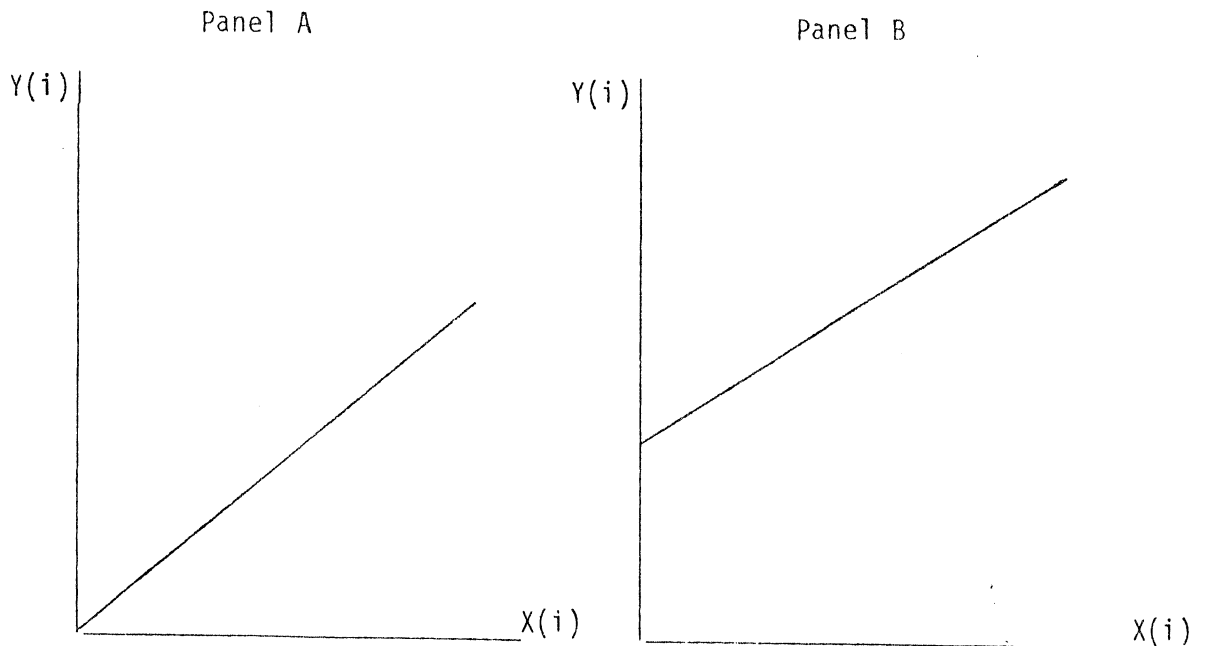
$$(4) \quad E(Y(i)) = B1 + B2 X(i) + B3 Z(i)$$

Now consider the two dimensional relationship between  $X(i)$  and  $Y(i)$  that may be demonstrated for fixed values  $Z(i)$  as shown in Figure 1 panels A and B. The regression line in panel A has either a positive slope for profitable firms (as shown) or a negative slope if the firms have losses. In either case the regression line must pass through the origin.<sup>1</sup> The profit level formulation shown in panel B provides for greater flexibility in that the regression equation is not constrained to pass through the origin. Because of this greater flexibility the level specification is employed for both profits and revenues in the subsequent analysis. The use of revenues as well as profits allows for the assessment of the degree to which firms are profit maximizers. This is discussed in the following section.

### 2. The Explanatory Variables

The percentage of total corporate sales accounted for by sales to government (GSALES) is used as a proxy for sales to the defense establishment. The relationship of this variable to the profits of firms in the defense industry is of primary interest in our analysis. Given the conflicting results reported by other researchers it is unclear whether the relationship between GSALES and profits should be positive or negative. Critics of the defense industry (of the military-industrial complex) are likely to argue that the relationship is posi-

Figure 1



Relationship of  $Y(i)$  and  $X(i)$  based on equation 1.

Relationship of  $Y(i)$  and  $X(i)$  based on equation 2.

tive. Those who believe that acquisition policies are effective argue that no systematic and significant relationship between the two variables exists. Finally those who argue that current acquisition policies and procedures are eroding the defense industrial base imply that the GSALES variable exerts a negative influence on profit levels.

In explaining the level of profits at the firm, level differences in the size of firms must obviously be controlled for. The size of the firm will be represented by the variable NETPL which measures the dollar value of assets and includes land, buildings, and equipment. Clearly, this variable should be positively related to a firm's profits.

In addition to firm specific variables, it is important to consider industry level variables that might also exert an influence. Several authors have shown that industries with higher concentration ratios have higher profit rates.<sup>2</sup> To find out if this same relationship holds for profit levels as well, we introduce the four-firm concentration ratio, CRFOUR, which measures the percentage of industry sales accounted for by the four largest firms in the

industry. If the profit rate results extend to profit levels then a positive sign should be observed for this variable.

Another industry level variable that has been used in explaining profits is the minimum optimal scale of plant (MOS). Perhaps the most detailed consideration of the MOS concept was presented by Cory (1981). The argument is straightforward. Unless a firm in a high MOS industry attains that high MOS level it will have a higher cost structure and therefore earn lower profits. As for the regression model used, the MOS variable is an industry variable which indicates the effect of a percentage change in the industry MOS on the profits of the firm.

At this point the determinants of profits may be expressed as follows:

$$(5) \quad \text{PROFITS}(i, j) = B1 + B2 \text{GSALES}(i) + B3 \text{NETPL}(i) \\ + B4 \text{CRFOUR}(j) + B5 \text{MOS}(j) + e(i, j)$$

where: PROFITS(i, j) = level of profits for the ith firm in the jth industry;  
 B1 = constant term;  
 B2, B3, B4, B5 = partial regression coefficients for the indicated control variables;  
 GSALES(i) = percentage of the ith firm's net sales accounted for by sales to the government (a proxy for sales to the defense establishment);  
 NETPL(i) = net plant in dollars for the ith firm;  
 CRFOUR(j) = percentage of jth industry net sales accounted for by the four largest firms in the jth industry;  
 MOS(j) = minimum optimal scale of plant in the jth industry; and  
 e(i, j) = error term.

Because we wish to determine the extent to which firms act strictly as profit maximizers, a revenue version of equation (5) is necessary. This is accomplished by substituting REVENUES - COSTS for PROFITS, moving COSTS to the right hand side of equation (5) and introducing a new parameter B6:

$$(6) \quad \text{REVENUES}(i, j) = B1 + B2 \text{GSALES}(i) + B3 \text{NETPL}(i) \\ + B4 \text{CRFOUR}(j) + B5 \text{MOS}(j) + B6 \text{COSTS}(i) + \\ e(i, j)$$

where: REVENUES(i, j) = net sales of the ith firm in the jth industry and  
 COSTS(i) = cost of goods sold for the ith firm.

If B6 is equal to one then costs come fully into play along with revenues that the full amount of costs may be subtracted from revenues and the firm demonstrates a strict profit maximizing orientation. If the firm ignores costs altogether and focuses on revenue maximization rather than profit maximization, the value of B6 will be zero. Consequently, a value of B6 between zero and one may be viewed as a measure of the degree of profit maximization orientation of the firm.

There is an additional complication. We believe that the profit maximiza-

tion coefficient (B6) may be a function of the percentage of firm sales to the government. To test this we introduce an interaction term between GSALES and COSTS:

$$(7) \quad \text{GSCOSTS} = (\text{GSALES}) \times (\text{COSTS}).$$

The resulting coefficient of the new variable (B7 in equation 8) indicates, for a given level of costs, what the effect of a 1 percent change of GSALES is on the profit maximization coefficient.

### 3. High Defense Commitment Firms

We are interested in evaluating the impact of increasing proportions of defense sales on profit and revenues. This means that the analysis is restricted to defense oriented industries as identified in Current Industrial Reports.

The evaluation also requires a distinction between firms who sell a relatively high percentage of their output to the Federal Government (High Defense Commitment Firms) and those that sell none or a relatively low percentage of their output to the Federal government (Low Defense Commitment Firms). Since sales to the government in support of national defense vary continuously from zero to one hundred percent of total firm sales, an infinitely adjustable degree of commitment ranging from totally non-defense oriented firms to totally defense oriented firms may be observed.

For instance, General Motors is nearly always listed as a major contractor to the Federal government, and the dollar value of its sales to the government is substantial. However, the sales of General Motors to the government are rarely as much as three percent of its net sales. Our contention is that General Motors would probably be unwilling to modify its overall corporate behavior and policy in order to sell three percent of its output to the government. Therefore, General Motors must be regarded as a low defense commitment firm.

On the other hand, Irvin Industries is considered a high defense commitment firm, even though its dollar volume of sales to the government is smaller than the dollar volume of government sales by General Motors. Irvin Industries sells about forty percent of its overall output to the Air Force and Army and, thus, defense sales are critical to the firm. A secondary objective then is to examine the differences in performance and behavior between those firms which concentrate their sales to the government and those that do not.

Unfortunately GSALES and GSCOSTS are continuous variables whose effects are captured only in a gradual manner and therefore do not express the difference that may exist between firms with and firms without a significant and substantial commitment to the defense market. One approach to representing this discrete, categoric difference between high and low defense commitment firms is to select some cut-off point such as twenty-five percent sales to the government and create a dummy variable (D1) with a value of "1" representing high defense commitment firms with twenty-five percent or more sales to the government and zero representing low defense commitment firms.

It is important to recognize the relationship between the dummy variable

just created and the variable GSALES that serves as the basis for creating it. Since small values of GSALES will represent the low defense commitment firms and large values of GSALES will represent high defense commitment firms, then at some key value of GSALES the underlying behavior of the firms will change causing the regression line to pivot and to head off in a new direction representing the new strategy and orientation of the firm based on its recognition of the importance of its government sales. However, common sense and casual observation would suggest that this point should not be represented by a sudden break in the regression line but rather by a fundamental change in direction. Compare Panels A and B in Figure 2 for an illustration of this difference.

In order to avoid an inexplicable discontinuity in the regression relationship as it relates to the GSALES variable, the dummy variable regression must be restricted to form a piecewise linear spline regression. This is accomplished by first adding the dummy variable D1 and the interaction term D1 GSALES (the product of D1 and GSALES) to the regression equation. This yields the following formulation for the revenue equation:

$$(8) \quad \text{REVENUES}(i, j) = B1 + B2 \text{ GSALES}(i) + B3 \text{ NETPL}(i) \\ + B4 \text{ CRFOUR}(j) + B5 \text{ MOS}(j) + B6 \text{ COSTS}(i) \\ + B7 \text{ GSCOSTS}(i) + B8 \text{ D1}(i) + B9 \text{ D1 GSALES}(i) \\ + e(i, j)$$

Relationship between Y(i) and X(i) if a dummy variable and restricted interaction term (see equations (9) and (10)) are used to distinguish between high and low defense commitment firms.

where: B2 through B9 = partial regression coefficients for the indicated variables;  
 GSCOSTS = an interaction term, the product of GSALES and COSTS;  
 D1 = binary variable such that 1 indicates high defense commitment firms and 0 indicates low defense commitment firms;<sup>3</sup> and  
 D1 GSALES = interaction term, the product of D1 and GSALES, indicating the relationship, if any, between government sales and revenues.

In order to accomplish this smooth transition, the two new variable terms, D1 and D1 GSALES, in equation 8 must sum to zero just as D1 switches from zero to one. The value of GSALES at this point maybe defined to be GSALE1 which satisfies the following condition:

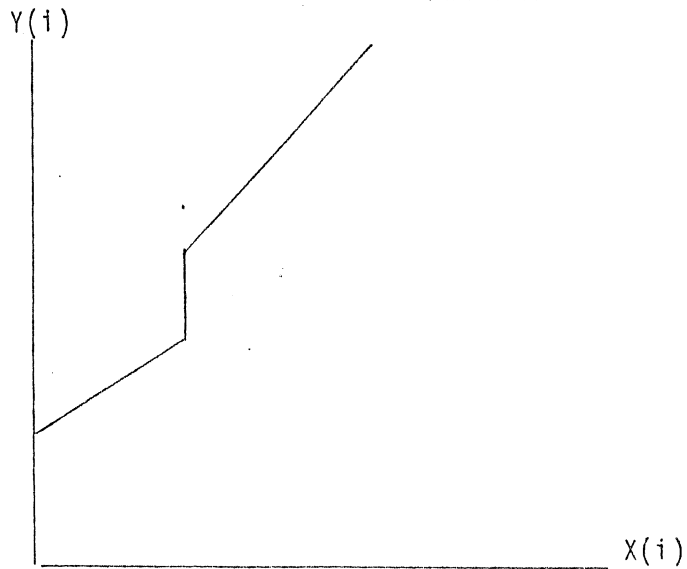
$$(9) \quad B8 \text{ D1} + B9 \text{ D1 GSALE1} = 0$$

Note that this equality holds only for the single point where GSALES = GSALE1 and not for greater or smaller values of GSALES. By solving equation (9) for B8 and substituting the resulting expression into equation (8), the following regression equation is obtained:

$$(10) \quad \text{REVENUES}(i, j) = B1 + B2 \text{ GSALES}(i) + B3 \text{ NETPL}(i) + B4 \text{ CRFOUR}(j) \\ + B5 \text{ MOS}(j) + B6 \text{ COSTS}(i) + B7 \text{ GSCOSTS}(i) \\ + B9 \text{ D1} (\text{GSALES}(i) - \text{GSALE1}(i)) + e(i, j)$$

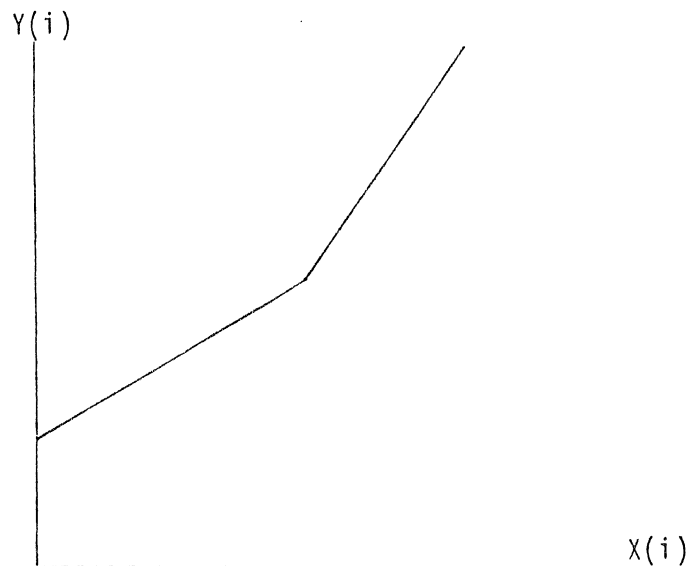
Figure 2

Panel A



Relationship between  $Y(i)$  and  $X(i)$  if a single dummy variable ( $D1$ ) is used to distinguish between high and low defense commitment firms.

Panel B



Relationship between  $Y(i)$  and  $X(i)$  if a dummy variable and restricted interaction term (see equations (9) and (10)) are used to distinguish between high and low defense commitment firms.

It is obvious that when  $GSALES = GSALE1$ , the term  $D1 (GSALES(i) - GSALE1(i))$  will be zero. This term will also be zero for all values of  $GSALES$  less than  $GSALE1$  since  $D1$  is zero by definition for all such values. This is illustrated in Figure 3 where the original regression line is represented by  $AGB$  and the new regression line, which changes for all values of  $GSALES$  that are greater than  $GSALE1$ , by  $AGC$ . For any particular value of  $GSALES$  that is greater than  $GSALE1$ , the impact of  $D2 (GSALES(i) - GSALE1(i))$  represents the vertical distance between the original line segment and the new line segment. This is shown as  $EF$  in Figure 3.

Any number of separate line segments may be created in this manner by specifying an appropriate value of  $GSALES$ , say  $GSALE2$ , with a corresponding dummy variable  $D2$  to form the restriction (effectively adding an arbitrary cut off point between high and low defense commitment firms):

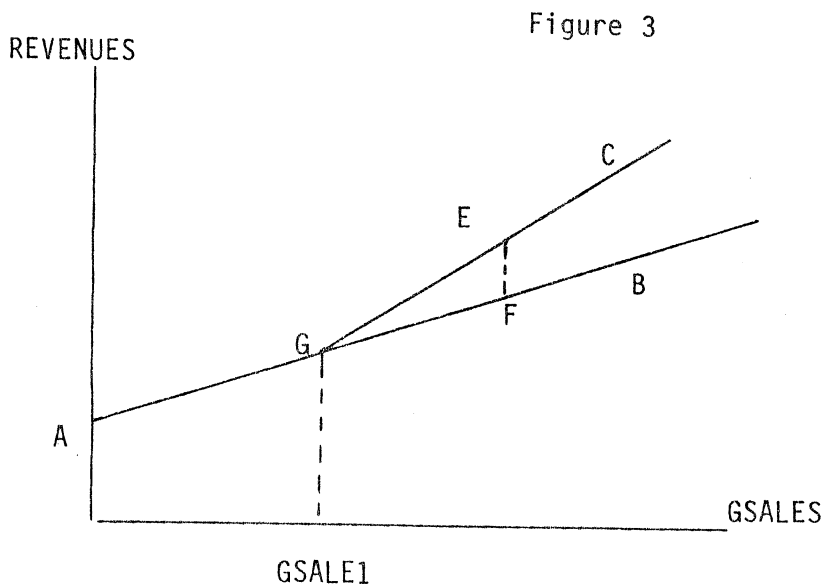
$$(11) \quad B10 D2 + B11 D2 GSALE2 = 0$$

This will result in a new term:

$$(12) \quad B11 D2 (GSALES - GSALE2)$$

Other line segments may be added in a similar manner.

One problem that becomes apparent with this method is the need to specify the number and location of the so-called spline knots, or, in this case, the values  $GSALE1$ ,  $GSALE2$ , and so on. If there is no clear cut a priori basis for specifying the number and location of these knots, then an estimation technique is needed to determine the number and location of the knots. For the current analysis a stepwise regression procedure was used to try all alternative possible knot locations in order to estimate the number and location of spline knots indicating changes in profit and revenue optimizing behavior. Since for each year 92 companies were available that met the conditions for inclusion in our analysis, there were 92 possible values for the  $GSALES$  variable that determine 92 corresponding dummy variables. Corresponding to these 92  $GSALES$  variable values, a set of 92 dummy variables were created that, in turn, determine the spline knot variables. The stepwise





procedure selects the first spline knot variable as in equation (8), and if that variable is statistically significant, it proceeds to select a second spline knot variable, and so on until such additional variables no longer contribute significantly to explaining the variation in the dependent variable. Being specifically devised for this analysis, this procedure provides a convenient and useful means of determining the number and location of knots or, in other words, pivot points or kinks, in the regression line.

### III. Empirical Results

In final form the regression equations for the levels of profits and revenues appear as:

$$(13) \text{ PROFITS}(i, j) = A + A1 \text{ GSALES}(i) + A2 \text{ NETPL}(i) + A3 \text{ CRFOUR}(j) \\ + A4 \text{ MOS}(j) + A5 \text{ D1}(\text{GSALES}(i) - \text{GSALEL}(i)) \\ + e(i, j)$$

and

$$(14) \text{ REVENUES}(i, j) = B + B1 \text{ GSALES}(i) + B2 \text{ NETPL}(i) + B3 \text{ CRFOUR}(j) \\ + B4 \text{ MOS}(j) + B5 \text{ COSTS}(i) + B6 \text{ GSCOSTS}(i) \\ + B7 \text{ D1}(\text{GSALES}(i) - \text{GSALEL}(i)) + e(i, j)$$

These regressions were estimated for a sample of 92 firms for each year from 1975 through 1979. These 92 firms were distributed across ten four digit Standard Industrial Classification Code industries. Appendix A presents definitions of all variables employed in the regressions as well as the sources for the data items. Appendix B provides descriptive statistics for the original data items for 1979. Appendix C indicates the distribution of the 92 firms across the ten four digit industries.

The results of the estimation procedure when applied to PROFITS are shown in Table 1. In evaluating these results consider first the two industry

TABLE I

REGRESSION RESULTS FOR PROFITS  
(T-STATISTICS IN PARENTHESES)

YEAR	CONSTANT!	GSALES	NETPL	CRFOUR	MOS	GS15	GS16	GS17
1975	8.54 (0.42)	3.56 (1.85)	1.205 (23.71)	0.026 (0.07)	-0.026 (-1.22)	667.19 (9.44)	-1397.32 (-10.58)	726.78 (11.03)
1976	10.48 (0.47)	3.18 (1.50)	1.256 (19.23)	0.069 (0.06)	-0.027 (-1.11)	706.93 (9.01)	-1467.79 (-9.97)	757.8 (10.30)
1977	6.35 (0.27)	3.47 (1.56)	1.466 (22.85)	0.15 (0.34)	-0.04 (-1.59)	757.37 (9.23)	-1571.00 (-10.20)	810.22 (10.50)
1978	4.46 (0.17)	3.75 (1.49)	1.58 (25.67)	0.22 (0.44)	-0.00 (-2.41)	894.98 (9.77)	-1850.96 (-10.77)	952.11 (11.05)
1979	10.72 (0.32)	6.02 (1.90)	1.57 (25.31)	0.23 (0.37)	-0.10 (-2.78)	929.38 (8.06)	-1967.56 (-9.11)	1032.13 (9.55)

variables CRFOUR and MOS. Both of these variables operated in a consistent manner. CRFOUR is positive in each year while MOS is negative in each year. The former result is in accord with a priori expectations although the effect is statistically insignificant.<sup>4</sup> The MOS results indicate that firms in industries with larger minimum optimal scale requirements have smaller profits than firms in industries with lower minimum optimal scale requirements, a result which is also in accordance with a priori expectations. MOS achieves a higher degree of statistical significance than CRFOUR becoming approximately significant in 1978 and 1979.

In terms of statistical significance the strongest variable is NETPL. This variable is more of a control variable than an explanatory variable. As might be expected the larger the firm as measured by NETPL the larger is its level of PROFITS.

Turning to the key variable for this analysis, we find a positive relationship between GSALES and PROFITS. That is, firms with greater percentages of sales to the government achieve higher levels of profits than firms with lower percentages of sales to the government. Reworded, doing business with the government enhances profit levels. Although this relationship is positive in each of the five years it never reaches statistical significance. Assuming that GSALES is an accurate proxy for defense sales then defense oriented firms earn greater profits but not in such excess as to be statistically significant.

The remaining variables in Table 1 are the three piecewise linear spline variables GS15, GS16, and GS17 and correspond to GSALE1 = 15 percent, GSALE2 = 16 percent, and GSALE3 = 17 percent, respectively. These spline knots were selected by the stepwise regression procedures and selected independently for each year analyzed. For each year the same three spline variables were statistically significant at the one percent level with no other spline variable being significant at this level. The effect of these three spline variables is to cause the regression line representing the effect of GSALES and PROFITS to flatten out somewhat. This means that PROFITS will not increase as rapidly in response to increases in GSALES after this variable reaches the seventeen percent level as they did before the fifteen percent level.

The cross section regressions yield coefficients of determination (R<sup>2</sup>) values all above .99. The high explanatory power is primarily due to the inclusion of NETPL among the set of independent variables.

Turning to the question of revenues, these regression results are presented in Table II. Again the discussion can begin with the impact of the two industry variables, CRFOUR and MOS. The four-firm concentration (CRFOUR) ratio returns a negative sign in 1975 and positive signs in each of the remaining four years. In all five years the impact of CRFOUR is not significantly different from zero thus resolving the problem of inconsistent sign. The MOS variable yields a consistent sign result, negative in each of the five years. In addition it borders on statistical significance. The negative sign suggests that firms in industries with larger minimum optimal scale requirements have smaller revenues than firms in industries with smaller minimum optimal scale requirements.

As for control of size effects, the REVENUE regressions contain two such

variables, NETPL and COSTS, and both variables operate exactly as expected. Both are positive and statistically significant in each and every year. But the COSTS variable does more than provide a control for size effects, it also provides us with the coefficient of profit maximization. The coefficient estimates for each of the five years, although significantly greater than

TABLE II  
REGRESSION RESULTS FOR REVENUES  
(T-STATISTICS IN PARENTHESES)

VARIABLE	YEAR				
	1975	1976	1977	1978	1979
CONSTANT	12.82 (.63)	14.05 (.65)	4.30 (.18)	-2.68 (-.10)	-3.22 (-.10)
GSALES	1.9165 (2.05)	3.7778 (1.82)	3.7385 (1.66)	3.5560 (1.41)	4.8498 (1.56)
NETPL	1.1340 (15.34)	1.0959 (10.70)	1.3567 (11.78)	1.5456 (12.73)	1.7734 (12.08)
CRFOUR	-.0581 (-2.19)	.0251 (.06)	.1247 (.28)	.2272 (.45)	.3035 (.49)
MOS	-.0581 (-2.19)	-.0603 (-2.10)	-.0490 (-1.56)	-.0543 (-1.55)	-.0409 (-.94)
COSTS	1.0173 (27.48)	1.0525 (26.50)	1.0598 (24.18)	1.0507 (24.00)	.9768 (20.38)
GSCOSTS	.0004 (.76)	-.0000 (-.03)	-.0007 (-1.18)	-.0010 (-1.85)	-.0008 (-1.34)
GS15	647.6 (8.42)	671.9 (8.21)	706.6 (7.85)	844.0 (8.48)	931.3 (7.84)
GS16	-.1364 (-9.42)	-1408.6 (-9.15)	-1474.7 (-8.71)	-1746.8 (-9.34)	-1951.9 (-8.76)
GS17	3712.7 (9.89)	732.9 (9.58)	764.5 (9.09)	899.5 (9.68)	1016.23 (9.16)

zero, are not significantly different from one. As argued previously this means that all the firms are the same: firms with a high defense commitment as well as those with a low defense commitment, demonstrate a strict profit maximization orientation. To repeat, all the firms in the sample are profit maximizers and not revenue maximizers.

With respect to the variables that relate specifically to government sales and their influence on REVENUES, we find the GSALES variable to be consistently positive but with varying degrees of statistical significance. This variable however never reaches statistical significance. The interaction variable GSCOST exhibits some variability in sign but is consistently insignificant.

The stepwise regression procedures indicate that the same three piecewise linear spline variables which were important in the PROFIT regressions are also important in the REVENUE regressions. In addition they operate in the same way. Thus, increases in GSALES will lead to increases in revenues but this relationship is weaker in magnitude after the seventeen percent level of GSALES is reached.

All of the coefficients of determination in the REVENUE regressions were above .99. Again the key to these high (for cross-sectional analysis) coefficients of determination is the inclusion of size variables among the set of explanatory variables. In this instance COSTS as well as NETPL represent size variables.

#### Conclusions

Our analysis of the defense industry suggests that in terms of profitability and revenue there is no advantage to be gained by a firm from increasing the proportion of its total sales which go to the military. As a corollary to this proposition we find that the firms examined are profit maximizers and are not content to simply maximize revenues. Another conclusion to be drawn from the empirical analysis is that there is a difference between high and low defense commitment firms and that this distinction occurs when the percent of sales to the government reaches the seventeen percent level. At this point the statistically weak but positive relationship between GSALES and PROFITS and REVENUES experiences a decrease in magnitude. Finally these conclusions emerge when controlling for other differences between firms including considerations regarding size and industry characteristics.

These conclusions are drawn from an analysis which suffers from several limitations which deserve explicit mention. The first limitation concerns the age of the two industry control variables. Ideally the values of CRFOUR and MOS would pertain to the specific years being evaluated. They do not; CRFOUR data are for 1972 and are invariant across regressions while MOS is for 1967 and is also invariant across regressions. But these items are probably not subject to much variation over time.

A second limitation is the inability to distinguish accurately between government sales and defense sales. In the current analysis it is simply assumed that the government sales of firms in those industries identified by the Bureau of Census to be defense oriented are defense sales. There is no reasonable way of assessing the validity of this assertion.

The third limitation involves the distinction between consolidated

corporations and the operating segments of these corporations. The defense activity of a consolidated corporation may be concentrated in a single segment of the corporation and excess (deficient) profits associated with the segment may be hidden when the unit of analysis becomes the consolidated corporation. We believe the corporate segment is indeed the appropriate unit of analysis but have utilized the consolidated corporation in order to maximize the number of firms included in the analysis. Prior research has supported the belief that the differences in results generated in this way are not significant.

#### Footnotes

1. This requirement may be seen most easily when equation 1 is solved for  $Y(i)$ ; that is, equation 1 can also be written as  $Y(i) = A_1 X(i) + A_2 Z(i) + e(i)$  in which there is no constant term.
2. For an example see Weiss (1974).
3. In the discussion the distinction between high and low defense commitment firms was assumed to arise at the 25% value for GSALES. It could be arbitrarily set at any other level.
4. Unless otherwise indicated statistical significance is evaluated at the five percent level.

#### Appendix A Data Definitions and Sources

1. PROFITS represents the net income of the firm and is defined as income after all operating and non-operating income and expense and minority interest, but before preferred and common dividends. It is taken from the COMPUSTAT Industrial File.
2. REVENUES represents the net sales of the firm and is defined as gross sales and other operating revenue less discounts, returns and allowances. It is taken from the COMPUSTAT Industrial File.
3. NETPL represents gross plant minus accumulated reserves for depreciation, depletion, and amortization. It is taken from the COMPUSTAT Industrial File.
4. COSTS represents the cost of goods sold and is defined as all costs directly allocated by the company to production; items such as material, labor and overhead. It is taken from the COMPUSTAT Industrial File.
5. GSALES represents the proportion of a firm's net sales (REVENUES) which are made to the government. Reworded, GSALES is the ratio of government sales to total sales. The government sales figures were obtained from the Disclosure, Inc. Securities and Exchange Commission Form 10k File while net sales or REVENUES was obtained from the COMPUSTAT Industrial File.
6. GSCOSTS represents a constructed interaction term and is defined as the product of GSALES and COSTS.
7. CRFOUR represents the four firm concentration ratio for the various four digit industries. A four firm concentration ratio is the percent of total industry sales accounted for by the industry's four largest firms. It is taken from the 1972 Census of Manufactures.
8. MOS represents the minimum optimal scale of plant for the various four digit industries. It is taken from P. Cory's "A Technique for Obtaining Improved Proxy Estimates of Minimum Optimal Scale".

## Appendix B

### Descriptive Statistics For Selected Regression Variables 1979

Regression Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
PROFITS (in millions)	\$165.25	\$361.20	\$.59	\$2,016.53
REVENUES (in millions)	\$573.28	\$1,309.27	\$2.71	\$8,131.00
NETPL (in millions)	\$92.16	\$199.64	\$.67	\$1,087.80
COSTS (in millions)	\$408.05	\$1,010.47	\$2.12	\$6,695.20
GSALES	20.42%	27.55%	0.00%	99.00%
CRFOUR	39.22%	19.46%	14.00%	74.00%
MOS (in millions)	\$139.21	\$347.27	\$4.38	\$1,333.58

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