

NSG-342



WORKING PAPERS  
DEPARTMENT OF ECONOMICS  
WASHINGTON UNIVERSITY  
ST. LOUIS, MISSOURI

GPO PRICE \$ \_\_\_\_\_

CFSTI PRICE(S) \$ \_\_\_\_\_

Hard copy (HC) \$1.00

Microfiche (MF) 50¢

ff 653 July 65

|                   |                                         |                  |
|-------------------|-----------------------------------------|------------------|
| FACILITY FORM 602 | N65-28870                               |                  |
|                   | (ACCESSION NUMBER)                      | (T/RU)           |
|                   | 16<br>(PAGES)                           | (CODE)           |
|                   | W63872<br>(NASA CR OR TMX OR AD NUMBER) | 34<br>(CATEGORY) |

An Exploratory Analysis of  
Defense/Space Companies

by  
Murray L. Weidenbaum  
Associate Professor of Economics  
Washington University  
Working Paper 6513

This research was supported in part by NASA research grant NSG-342 to Washington University.

St. Louis, Mo.  
June, 1965

## An Exploratory Analysis of Defense/Space Companies /1

By Murray L. Weidenbaum

In a small way, this study attempts to respond to the recent challenge of Professor George Stigler to his fellow economists: "The economic role of the state has managed to hold the attention of scholars for over two centuries without arousing their curiosity...Why have not the effects of the regulatory bodies on prices and rates been ascertained?.. Why has not the degree of success of governments in bringing together private and social costs been estimated?" /2

In good measure, some of Professor Stigler's questions have not been answered because of lack of available, usable data. This, then, is an exploratory effort at examining the impact of the role of the state in its relationships with the private economy. We start with a small sample of statistical data and then go on to consider the questions of public policy that can be dealt with. }

It has become fashionable in recent years to castigate once again "munitions lobbyists" and a "military-industrial complex" and to bemoan their influence on the civilian economy. In contrast, little thought or analysis has been devoted to the impact of the impact of the close governmental relationship on the industries directly involved. It is the purpose of this paper to illuminate some aspects of the latter relationship.

[ Table 1 shows the extent to which the 35 companies receiving the largest amounts of orders from the Department of Defense and the National Aeronautics and Space Administration are dependent on such governmental contracts. Clearly, some of the firms, particularly the electrical equipment and automobile firms, receive large absolute amounts of government contracts, but proportionately still devote the bulk of the efforts to serving consumer and industrial markets in the private economy. In contrast, other--more specialized--companies, notably those in the aerospace industry, are primarily suppliers of goods and services to the Federal Government.

For purpose of further analysis, let us take six of the aerospace companies listed in Table 1 for which, by the rough estimates shown there, military/space work accounts for one-half or more of their total sales. Three of these companies are in the 75-100% category of dependence (Lockheed, McDonnell, and North American), and three in the 50-75% group (Boeing, Douglas, and United Aircraft). The next section of this article compares this sample of companies with a group of six firms of roughly equal size which cater primarily to the private economy--American Can, International Harvester, Johns-Manville, National Dairy Products, National Steel, and Union Carbide. This second set of companies was arrived at by selecting the companies in the FORTUNE list of the 500 manufacturing companies with the highest sales volumes which were adjacent to the six defense/space firms for the same period covered in table 1. Both groups accounted for approximately equal sales volumes in 1962--\$7.5 billion for the government-oriented firms and \$7.6 billion for the other (see Table 2).

Importance of Defense-Space Orders to 35 Major Companies  
Fiscal Year 1962

| Company                                   | (1)<br>Defense<br>And NASA<br>Contracts<br>(millions) | (2)<br>Company<br>Sales <sup>a</sup><br>(millions) | (3)<br>Ratio of<br>Orders to<br>Total Sales<br>(1)/(2) |
|-------------------------------------------|-------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|
| <u>75-100%</u>                            |                                                       |                                                    |                                                        |
| Republic Aviation Corp.                   | \$ 339.7                                              | \$ 4295.8                                          | \$100.0+%                                              |
| McDonnell Aircraft                        | 379.4                                                 | 390.7                                              | 97.11                                                  |
| Grumman Aircraft Engineering Corp.        | 328.2                                                 | 357.1                                              | 91.91                                                  |
| Lockheed Aircraft Corp.                   | 1,424.5                                               | 1,753.1                                            | 81.27                                                  |
| AVCO Corp.                                | 324.7                                                 | 414.3                                              | 78.37                                                  |
| North American Aviation, Inc.             | 1,231.6                                               | 1,633.7                                            | 75.39                                                  |
| Hughes Aircraft Corp.                     | 243.4                                                 | b                                                  | c                                                      |
| <u>50-74%</u>                             |                                                       |                                                    |                                                        |
| Collins Radio Co.                         | 153.8                                                 | 207.8                                              | 74.01                                                  |
| Thiokol Chemical Corp.                    | 179.1                                                 | 255.8                                              | 70.02                                                  |
| Raytheon Co.                              | 406.6                                                 | 580.7                                              | 70.02                                                  |
| Newport News Shipbuilding & Dry Dock Co.  | 185.0                                                 | 267.3                                              | 69.21                                                  |
| Martin Marietta Corp.                     | 804.5                                                 | 1,195.3                                            | 67.31                                                  |
| Boeing Co.                                | 1,148.4                                               | 1,768.5                                            | 64.94                                                  |
| General Dynamics Corp.                    | 1,224.5                                               | 1,898.4                                            | 64.50                                                  |
| Curtiss-Wright Corp.                      | 144.6                                                 | 228.7                                              | 63.23                                                  |
| United Aircraft Corp.                     | 696.8                                                 | 1,162.1                                            | 59.96                                                  |
| Douglas Aircraft Company, Inc.            | 434.0                                                 | 749.9                                              | 57.87                                                  |
| <u>25-49%</u>                             |                                                       |                                                    |                                                        |
| American Machine & Foundry Co.            | 187.3                                                 | 415.4                                              | 45.09                                                  |
| General Tire & Rubber Co.                 | 432.5                                                 | 959.8                                              | 45.06                                                  |
| Northrop Corp.                            | 153.8                                                 | 347.5                                              | 44.25                                                  |
| Hercules Powder Co.                       | 181.6                                                 | 454.8                                              | 39.93                                                  |
| Sperdy Rand Corp.                         | 467.8                                                 | 1,182.6                                            | 39.56                                                  |
| Bendix Corp.                              | 305.3                                                 | 788.1                                              | 38.74                                                  |
| F M C Corp.                               | 160.4                                                 | 506.5                                              | 31.67                                                  |
| Pan American World Airways, Inc.          | 146.7                                                 | 503.9                                              | 29.11                                                  |
| <u>0-24%</u>                              |                                                       |                                                    |                                                        |
| International Telephone & Telegraph Corp. | 245.8                                                 | 995.5                                              | 24.69                                                  |
| General Electric Co.                      | 998.9                                                 | 4,792.7                                            | 20.84                                                  |
| Radio Corporation of America              | 359.8                                                 | 1,742.7                                            | 20.65                                                  |
| Westinghouse Electric Corp.               | 249.4                                                 | 1,954.5                                            | 12.76                                                  |
| International Business Machines Corp.     | 168.1                                                 | 1,925.2                                            | 8.73                                                   |
| American Telephone & Telegraph Corp       | 478.5                                                 | 11,742.4                                           | 4.07                                                   |
| Ford Motor Co.                            | 269.1                                                 | 8,089.6                                            | 3.33                                                   |
| General Motors Corp.                      | 450.4                                                 | 14,640.2                                           | 3.08                                                   |
| Standard Oil Co. (New Jersey)             | 180.1                                                 | 9,537.3                                            | 1.89                                                   |

a. Net sales for fiscal year ending during 1962.

b. Not available.

c. Estimated from other sources to be in excess of 75 percent.

NOTE: Because of the importance of subcontracts received by some of the listed firms, the ratio of defense-space orders to total sales may not always be an accurate indicator of the actual ratio of military-space work to total company activity.

Source: Company annual reports for sales data; Department of Defense and National Aeronautics and Space Administration releases for contract data.

Table 2

Selected Data On Six Aerospace Companies and Six  
General Industrial Corporations

(Data for 1962. Dollar Figures in Millions)

| Rank<br>in<br>Fortune<br>500 | Company                 | Head-<br>quarters | Sales   | Assets  | Net<br>Profit | Year<br>End<br>Net<br>Worth | Profit/<br>Sales | Profit/<br>Net<br>Worth | Year End<br>Employment<br>(thousands) |
|------------------------------|-------------------------|-------------------|---------|---------|---------------|-----------------------------|------------------|-------------------------|---------------------------------------|
|                              |                         |                   |         |         |               |                             |                  |                         |                                       |
| 21                           | International Harvester | Illinois          | \$1,837 | \$1,527 | \$ 60         | \$1,051                     | 3.3%             | 5.7%                    | 102                                   |
| 22                           | National Dairy          | New York          | 1,821   | 774     | 51            | 482                         | 2.8              | 10.6                    | 48                                    |
| 23                           | Boeing                  | Wash              | 1,769   | 648     | 27            | 271                         | 1.5              | 10.0                    | 104                                   |
| 24                           | Lockheed                | Calif.            | 1,753   | 598     | 50            | 177                         | 2.9              | 28.4                    | 80                                    |
| 26                           | North American          | Calif.            | 1,634   | 663     | 35            | 239                         | 2.1              | 14.4                    | 98                                    |
| 27                           | Union Carbide           | New York          | 1,631   | 1,792   | 160           | 1,070                       | 9.8              | 14.9                    | 58                                    |
| 38                           | American Can            | New York          | 1,181   | 959     | 49            | 552                         | 4.1              | 8.8                     | 47                                    |
| 39                           | United Aircraft         | Conn.             | 1,160   | 538     | 18            | 290                         | 1.6              | 6.2                     | 63                                    |
| 64                           | Douglas                 | Calif.            | 750     | 376     | 110           | 135                         | 1.4              | 7.5                     | 44                                    |
| 65                           | National Steel          | Pa.               | 745     | 903     | 36            | 538                         | 4.8              | 6.6                     | 26                                    |
| 133                          | Johns-Manville          | New York          | 392     | 349     | 24            | 287                         | 6.1              | 8.3                     | 220                                   |
| 134                          | McDonnell               | Missouri          | 391     | 149     | 14            | 83                          | 3.6              | 16.6                    | 24                                    |

Source: "The 500 Largest U.S. Industrial Corporations," Fortune, July 1963, pp. 177-196.

When these two groups of companies are compared, significant and measurable differences are found in their basic characteristics. Some of these differences are not merely ones of degree but are fundamental and pervasive. They range from the nature of product development decisions to price determination, profit rates, provision of working capital and research and development funds, source of plant and equipment, nature of the work force, and remuneration of top management.

#### Financial Characteristics

The defense/space contractors tend to operate on far smaller profit margins than the commercially-oriented companies. These respective net profits expressed as a percent of sales were 2.2 percent and 5.2 percent. Naturally, this is the comparison most frequently used by defense industry spokesmen in their public statements. However, other aspects of the comparative financial characteristics are also of interest. For example, because of the large amounts of manufacturing and research plant and equipment which is made available to them by the defense establishment, defense/space contractors report a far higher rate of capital turnover (i.e., dollars of sales per dollar of company-owned assets): 2.5 versus 1.2 for the two samples. To some extent, the lower profit margins and higher turnover rates for defense companies tend to offset each other. However, the return on net worth (after-tax net profits as percent of stockholders investment) is higher on balance for the sample of government contractors (13.8 percent versus 9.2 percent in 1962). This latter comparison may be the most germane financial one. <sup>13</sup>

### Investor Evaluation

The stock market's evaluation of the defense companies appears to be less favorable than that of the general industrial corporations. The inherent instability of the governmental market and the historical volatility of the fortunes of individual defense contractors are undoubtedly important influences. Also, the lower payout ratio (the proportion of net income which is actually disbursed to stockholders in the form of cash dividends) is a related influence. In 1962, this ratio was only 38 percent for the aerospace companies and 66 percent for the general industrial firms. As a result of these factors, the earnings of the military firms tend to be discounted as shown by the lower price/earnings multiple (13 versus 16 1/4).

Bondholders also tend to treat the securities of defense-oriented firms differently than those of the firms in the non-defense sample. Where bonds are outstanding, Moody's, the standard financial rating service, has categorized those of the defense companies as Baa (lower medium grade) or Ba (speculative) and those of the other companies as A (higher medium grade) or Aa (higher quality).

### Capital Structure

The relatively small degree to which aerospace companies rely on their own physical assets can be seen by their far lower ratio of company-owned plant and equipment to sales (7 percent vs 26 percent); indirectly, of course, this indicates the importance of government-supplied capital.

A somewhat similar relationship prevails when crude ratios are prepared of capital to output (taken as the ratio of depreciated plant and equipment as carried on the company books to "value added" or in-house effort). For the general industry sample, the capital/output ratio was 1.4, indicating that \$1.40 of capital was required, on the average, for each \$1.00 of output. For the aerospace companies, the capital output ratio was only 0.2.

In contrast to recent discussions of the tendency for military contractors to make a profit "on a profit"--on work primarily performed by subcontractors who themselves earn profits--their ratio of in-house effort (value added to sales) is slightly higher than for the other companies (33 percent compared to 28 percent). That is, defense contractors tend to subcontract less and do more of the total work themselves than is the case for the sample of general industrial corporations. This may be another example of the value of obtaining some data in order to verify, or contradict, previously untested assumptions concerning government-industry relationships.

#### Research and Development

Science and engineering perform a much larger role for defense/space contractors than in other branches of business activity. Based on data of the National Science Foundation for the industries in which the 16 sampled firms are located, it is estimated that expenditures for research and development account for 22.5 percent of the sales of the defense group and 4.3 percent for the other.

In good measure, this situation results from the tremendous amount of government research and development contracts which companies serving defense

and space markets receive. About 90 percent of their R&D is so financed, and only 40 percent for all other companies. However, the defense firms also devote a somewhat higher proportion of their own resources to R&D than does private industry as a whole (R&D was 2.6 percent of sales compared to 1.8 percent for other companies). As a result in good measure of the heavy R&D outlays, a far greater portion of the typical defense/space company work force consists of scientists and engineers doing research and development work than is the case for the average company serving private markets.

#### Manpower

The high proportion of engineers and other professional employees which is characteristic of defense and space work is reflected in the greater average payroll cost per employee (\$7,457 versus \$5,770). However, this factor is also seen in the higher dollar volume of sales per employee (\$18,040 to \$13,865). Of course, the latter situation may reflect the "cost plus" nature of much of government procurement.

In striking contrast, the average chief executive of an aerospace company receives a significantly lower salary (\$148,600) than his counterpart in other industries (\$222,600). This too, may be a consequence of the close relationships between the defense/space industry and governmental customer; hence, the tendency for the relatively low pay structure of the Federal Government to exert a dampening influence on the salaries of the managements doing business primarily with governmental procurement agencies.

### Stage in the Growth Cycle

Characteristically, the defense-space market has been a major growth area of the American economy; the dominant firms in the field have experienced far more rapid increases in sales, employment, profits, and net worth than has been the case for the other large industrial corporations generally.

For example, total employment in the sample of aerospace companies increased 52 percent over the past decade and only 11 percent for the general industrial firms. For sales, the respective growth was 170 percent and 61 percent.

Primarily, the relatively more rapid growth pattern of the large defense-space contractors may result from the equally rapid expansions in the requirements of the governmental customers. In part, it may also reflect the relative youth of the firms in the industry (39 years versus 62 years for the two samples).

The tendency for the firms in the defense industry to cluster in several areas in the western part of the United States has had an important effect on the pattern of regional development in the nation during the postwar period; most studies of the subject tend to conclude that defense production work was a major factor in the relative growth rates of various states and metropolitan areas in the postwar period. Not coincidentally, the headquarters and major production and research facilities of five of the six companies in the defense sample are located west of the Mississippi River. The headquarter offices, at least, of all six nondefense companies are east of the Mississippi.

The Role of the Customer

The government represents, for the specialized defense/space suppliers, essentially a monopsonistic or one-customer market. Different agencies of the Department of Defense procure varying items, but sales are all made fundamentally to the military establishment under the Armed Services Procurement Regulation and similar establishment-wide legislation and regulations. The Armed Services Procurement Regulation, unilaterally, establishes numerous aspects of the relationship.

The distinguishing role of the governmental customer also extends to the internal operations of defense/space companies. It covers such aspects as financial reporting systems, industrial engineering and planning (the compulsory use of PERT/COST systems for example), limitations on the use of overtime, purchases from abroad, restrictions on charitable contributions, patents, and pay rates. Most of these requirements on the companies supplying the Department of Defense and NASA result from entering into contractual relationships with the government. The bulk of these requirements arise either from congressional legislation or standard military procurement regulations. <sup>4</sup>

A recent example of the close governmental relationship is afforded by a report of the U.S. General Accounting Office, contending that the leasing of computer systems by a defense contractor is costing the Federal Government more than if the Government purchased the equipment and furnished it to the contractor. The company, in turn, contended that the high rate of obsolescence of computer equipment made rental the more economical choice. Although neither argument is in terms of management prerogative, the GAO rebuttal, is significant.

It countered by saying that because the Government, in effect, is bearing most of the cost of rentals of computer systems used by defense contractors, it "should have the right to manage the equipment in such a manner as to fulfill the Government's needs at least cost. <sup>5</sup>

Quite naturally, the relationship between the defense/space companies and the Federal Government has been the cause for considerable and extended public concern and questioning. Some observers have even referred to this as "symbiotic" relationship, a status described by Webster's as "living together. . . where the association is advantageous, or often necessary, to one or both, and not harmful to either."

To be sure, both the industry and the government each bring certain strengths to the bargaining relationship, and each has some weaknesses. For example, the Federal Government, particularly acting through the military establishment, is responsible for national survival. This awesome responsibility gives it a high degree of ultimate authority over the entire relationship.

The military establishment itself possesses the inherent power of the single buyer over the competitive seller. The buyer can choose among alternative sellers. In practice, the seller -- i.e. the specialized defense company -- has little alternative, as witnessed by the singular lack of success experienced by defense companies in attempting to diversify into nongovernmental markets. As a result of the locked-in or captive nature of many of these suppliers, government procurement legislation and regulations unilaterally determine crucial aspects of governmental-industry relationships.

Also, the power to unilaterally modify a portion of the relationship, through contract cancellations or other change, is one of the government's major inherent strengths and industry's inherent weaknesses. The government's power, through renegotiation, to determine, after the fact, the amount of profit that the individual contractor may retain is a very basic piece of authority in a private enterprise economy based on the profit motive.

Defense/space contractors are not without strengths of their own. In the absence of a well-developed arsenal system, they represent at the present time at least the backbone of the nation's scientific and engineering capability and especially the capability from which the government can draw for the development and production of weapon and space systems.

Also, the defense/space industry has considerable discretion and ability to marshal relatively large amounts and high quality of the resources devoted to contracting and other matters critical to its business objectives--scientists, engineers, accountants, attorneys, and contract negotiators and administrators.

Moreover, the company which has performed a large portion of the work on a given weapon or space system up to a certain point generally has more bargaining power because the customer knows that it is likely to do a more proficient and economical job on the remainder of the work than a second company starting afresh.

In addition, the fact that a given company has devoted a considerable amount of effort and hence gained some expertise on a given defense or space product provides its representatives with a goodly amount of technical

authoritativeness in negotiating contractual changes and in other contract administration matters. On balance, of course, public and legislative attention is focused on those examples where the company representatives have pushed (or inadvertently received) too good a bargain. The reverse situation is hardly newsworthy.

#### Overall Impact of the Customer Relationship

Viewed in a broad and relatively long-term perspective, the defense/space industry is becoming a regulated industry and in such a unique fashion as possibly to justify at times the term "semi-nationalized." The regulation is not accomplished through an independent commission before which the public and the industry can present their cases, as with utilities and other "public service" industries. It is performed, rather, unilaterally through procurement regulations and other provisions included in government contracts. These provisions, which are not customarily found in private business arrangements, range from those designed to protect the government as a customer to those attempting to encourage a large and growing variety of social and economic objectives.

The ultimate impact of this form of regulation is yet to be determined. The measurable differences in the characteristics of large, specialized defense/space companies described above may be indicative of the subtle but fundamental changes which can take place within these companies. Moreover, the essentially passive reaction of the major defense contractors to the cutbacks and other adverse developments in the military market during the

past year also may be indicative of the qualitative changes which accompany the close continuing relationship between a private enterprise and of governmental organization. The defense/space companies attend numerous meetings and conferences on defense industry "conversion" and related topics and subscribe to background staff studies. However, in general, they still await the government's request for proposals before committing any significant amount of funds to developing new, civilian applications of their much-vaunted defense/space technology and systems management capability. The major nonaerospace diversification efforts at the present time have centered on the government market, such as cost-plus-fixed-fee contracts with the Office of Economic Opportunity to operate Job Corps installations or small exploratory research contracts with the state of California. These have not been the results of company entrepreneurial efforts but of governmental requests for proposals.

To some degree, the initiative, risk-bearing and similar manifestations of enterprise appear to have become characteristics of the buyer rather than the seller in the large and rather unique sector of the American economy dominated by military and space requirements. This relatively unnoticed development may be reason for further study by those concerned with the prospects for future economic growth and technical innovation in the United States.

# Footnotes

<sup>/1</sup> An earlier version of this paper appeared in the April 1965 issue of Challenge, The Magazine of Economic Affairs, published by New York University.

<sup>/2</sup> George J. Stigler in his presidential address to the American Economic Association, Chicago, Illinois, December 29, 1964.

<sup>/3</sup> For additional financial comparisons, such as return on total capital, see Stanford Research Institute, The Industry-Government Aerospace Relationship, Menlo Park, California, 1963.

<sup>/4</sup> For further detail, see M. L. Weidenbaum, The Military Market in the United States, Chicago, American Marketing Association, 1963.

<sup>/5</sup> Reported in the St. Louis Post-Dispatch, January 22, 1965, p. 8A.