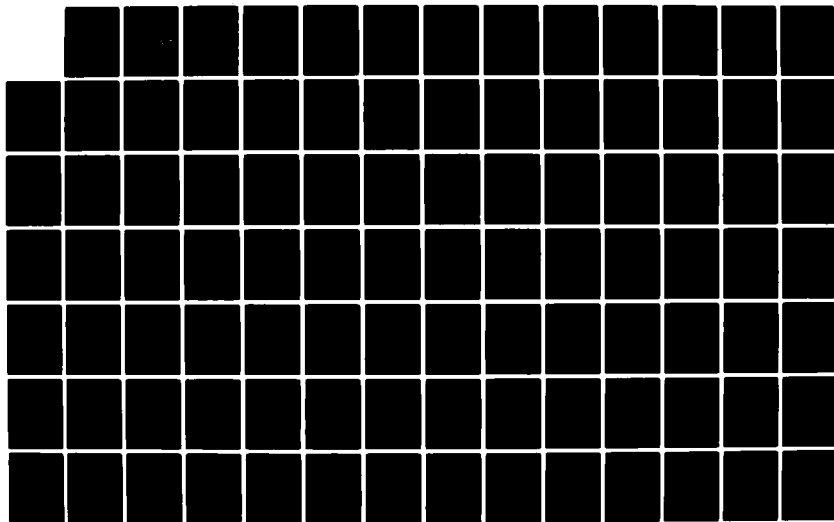AD-A121 646   EFFECT OF INFLATION RELATED FACTORS UPON BUSINESS FIRMS   1/2
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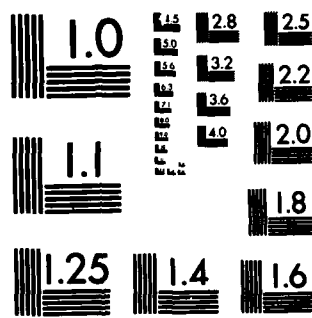   NOTRE DAME UNIV IN   J G BEVERLY ET AL. DEC 81
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Phase II examines the behavior of some 1000 public corporate segments in the aerospace industry. It concentrates on the impact of sales to the government and the Air Force on various aspects of firm performance including profitability, efficiency, and capital management.

The data for the analysis are drawn from Standard and Poor's COMPUSTAT Business Information File; Disclosure, Inc.; Securities and Exchange Commission

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Form 10K data; the World Aviation Directory; and the Individual Contract
Action Reports (Department of Defense Form 350).

Two methodologies are employed. The first compares those firms with no
sales to the government with those that have 75 percent, 50 percent, and
25 percent sales to the government. Statistical tests for differences in
means are employed. This analysis is replicated for those firms with no
sales to the Air Force and those with 75 percent, 50 percent, and 25 percent
sales to the Air Force. The second methodology involves multiple regression
analysis. Here the impact of government and Air Force sales are evaluated
while controlling for other differences between firms including differences
in size, efficiency, and type of aerospace producer. The regression analysis
also includes separate evaluation of all public aerospace firms and those
public aerospace firms in the 3000-3999 Standard Industrial Classification
four digit industries. Both methodologies are employed in examining the
data for 1977, 1978, and 1979.

The conclusions drawn from the regression analysis suggest that Air Force
acquisition procedures are neutral; that is, there is no significant
advantage or disadvantage to be gained by a firm as it concentrates a
greater proportion of its sales to the Air Force. But the positive
and statistically significant order backlog ratios indicate that the Air
Force will generally be unable to move quickly in securing greater volume
of output.

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Effect of Inflation Related Factors upon
Business Firms Acting as Suppliers to the
United States Air Force (Phase II)

Final Report

To

Air Force Business Research Management Center
Wright-Patterson Air Force Base
Dayton, Ohio   45433

By

John G. Beverly, Associate Professor of Accountancy
Frank J. Bonello, Associate Professor of Economics
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December 31, 1981

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EXECUTIVE SUMMARY

The Phase II analysis examines the behavior of some 1000 public corporate segments in the aerospace industry. It concentrates on the impact of sales to the government and sales to the Air Force on various aspects of firm performance including profitability, efficiency, and capital management.

The data for the analysis are drawn from Standard and Poor's COMPUSTAT Business Information File; Disclosure, Inc., Securities and Exchange Commission Form 10K data; the World Aviation Directory; and the Individual Contract Action Reports (Department of Defense Form 350).

Two methodologies are employed. The first compares those firms with no sales to the government with those that have 75 percent, 50 percent, and 25 percent sales to the government. Statistical tests for differences in means are employed. This analysis is replicated for those firms with no sales to the Air Force and those with 75 percent, 50 percent, and 25 percent sales to the Air Force. The second methodology involves multiple regression analysis. Here the impact of government sales and Air Force sales are evaluated while controlling for other differences between firms including differences in size, efficiency, and type of aerospace producer. The regression analysis also includes separate evaluation of all public aerospace firms and those public aerospace firms in the 3000-3999 Standard Industrial Classification four digit industries. Both methodologies are employed in examining the data for 1977, 1978, and 1979.

As for the conclusions drawn from the regression analysis they can be summarized as follows.

> **Profitability**. Government sales have no statistically significant impact on profit margin ratios but a positive and statistically

significant impact on return on investment. Air Force sales on the other hand have no statistically significant impact on profit margin ratios or return on investment. (Unless in the latter measure the analysis is restricted to firms in the 3000-3999 SIC industries).

Efficiency. There is no statistically significant impact of government sales on cost of goods sold ratios but a negative and occassionally significant impact on capital output ratios. Air Force sales have no statistically significant impact on either the cost of good sold or capital output ratios.

Capital Management. Government sales tend to have a statistically significant impact only when the analysis is restricted to firms in the 3000-3999 SIC codes. Here increases in the relative importance of government sales increases the gross replacement, net replacement, and capital change ratios. Air Force sales do not have any statistically significant impact on the gross replacement, net replacement, or capital change ratios.

Other Areas. Government sales have a positive and statistically significant impact on both labor output and order backlog ratios but not on research to sales ratios. Air Force sales, however, exert a positive and statistically significant impact on order backlog and research to sales ratios but no statistically significant impact on labor-output ratios.

Overall these results suggest that Air Force acquisition procedures are neutral; that is, there is no significant advantage or disadvantage to be gained by a firm as it concentrates a greater proportion of its sales to the Air Force. But the positive and statistically significant order backlog ratios indicate that the Air Force will generally be unable to move quickly in securing greater volume of output.

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Appendix A.   Glossary of Variable Names.

Appendix B.   Corporate Structure.

Appendix C.   Consolidated Corporations Included in the Data Base
               for the Phase II Analysis (1979).

CHAPTER I. INTRODUCTION

This report constitutes a summary of the activities undertaken in
connection with "A Proposal to Conduct Basic and Applied Research into
the Effect of Inflation Related Factors Upon Business Firms Acting as
suppliers to the United States Air Force: Phase II: Applied Research
Component." It is a more specific analysis than the Phase I research;
it involves a more detailed methodology, a focus on a more appropriate
unit of analysis, and more precisely defined research questions. But
just as Phase I served as a base for Phase II, Phase II must also serve
as a base for future research. Phase II conclusions are not tentative,
rather, Phase II indicates some areas for investigation that necessarily
must be undertaken at some subsequent time.

Inasmuch as Phase II builds on Phase I, it may be useful in this
introduction to review briefly the substance of Phase I. Although this
review is no substitute for a careful reading of the Phase I final report,
it will serve to set the stage for the Phase II analysis.

A. PHASE I REVIEW

The initial objectives of the Phase I research were: (i) to assess
the impact of inflation on the procurement process of the U.S. government
in the defense area, and (ii) to evaluate the impact of inflation on
defense suppliers as compared to non-defense suppliers. Since that

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phase was basic research different specific objectives evolved. A review
of procurement procedures was accomplished but was de-emphasized. The
assessment of the impact of inflation on these procedures was restricted
to a section dealing with contracts and the contracting process.

The evaluation of firm behavior became the focal point for Phase I
and was extended to include more than the consequences of inflation.
Comparison of defense suppliers with other firms in fact extended to
five different areas of firm behavior: corporate liquidity and working
capital management, profitability, production efficiency, inflation
reaction, and product specialization. In each of these areas, several
different measures of firm behavior were used. In most instances these
measures involved standardized accounting ratios. For example, in the
profitability area the measures included the profit margin ratio and the
price earnings ratio as well as return on investment and return on equity.

Two different approaches were used to evaluate the performance of
defense suppliers relative to non-defense firms in each of the five
areas. The first approach involved a modified means test; that is, the
average of a particular ratio for the defense suppliers within a particular
Standard Industrial Classification (SIC) four-digit code was compared to
the average value of the ratio for non-defense firms in that same SIC
code. These SIC codes were primarily limited to those associated with
the aerospace industry. The specific steps involved were as follows:
(i) identify firms that sold 13 percent or more of their output to the
U.S. government ("primes"); (ii) identify firms that sold less than 13
percent of their output to the U.S. government ("controls"); (iii) arrange
primes and controls by four-digit SIC code; (iv) for each SIC code calculate
the mean ratio values for primes and controls; and (v) evaluate the

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difference in prime and control behavior on a particular measure or
ratio in terms of the relative frequency in which prime and control
behavior deviated across SIC codes.

The second approach employed to analyze differences in defense and
non-defense firms involved stepwise regression procedures. In this
instance a set of macro (major) independent variables was constructed.
These represented factors related to the efficiency and the factor mix
employed by firms that might account for differences in the performance
of the various firms. The identification of a firm as a government
supplier (control) was captured by a continuous variable: percent of
sales to the government. Each of the ratios from each of the five areas
of firm behavior was then regressed against the set of independent variables.

The two procedures were viewed as supplements rather than substitutes.
The mean ratio comparisons provided an introductory analysis which would
suggest specific hypotheses, and make one familiar with the data, the
various measures of firm behavior, and the distribution of the defense
industry across the SIC codes. The regression analysis was necessary
because the mean ratio comparisons could reveal differences but could
not determine whether the differences were due to a firm's status as a
defense supplier or some other factor such as firm size, efficiency, or
factor mix. Regression procedures allow for such an evaluation.

In terms of the conclusions drawn from the regression analysis,
there are several sharp distinctions between firms that are government
suppliers and firms that are not government suppliers. Within the corporate
liquidity and capital management area, inventory turnover and the working
capital ratio increased as the percent of sales to the government increased.
However, cash flow and length of the collection period were not significantly

different. The second area of analysis concerned profitability. For
each of the four ratios examined, there was no systematic relation with
the relative share of sales going to the government; that is, no difference
in profitability between primes and controls. Production efficiency
represented the third area. Here the primes had significantly higher
cost of sales ratios, significantly higher labor-output ratios, and
significantly lower capital-labor ratios. This suggests that government
suppliers are more labor intensive and less efficient than non-government
firms. The fourth area of investigation involved inflation reaction.
For only one of seven ratios included in this area was there a strong
relationship with percent of sales to the government: as this percent
increased, so did the defensive asset ratio (ratio of cash plus receivables
plus marketable securities to the sum of cost of goods sold plus other
out-of-pocket operating expenses). The fifth and final area concerned
product specialization and included eight different elements. As for
significant differences between primes and controls, only two were isolated:
primes had a significantly higher ratio of order backlog to sales and a
significantly lower raw materials inventory to sales ratio.

Overall Phase I uncovered little evidence to support the charge
that government suppliers earn larger profits than their non-government
counterparts. But there is some evidence of difficulty within the industrial
base. These include the order backlog problem and a potential for raw
materials inventory supply problems. The results for these two measures
imply that it would be difficult for firms to respond quickly to a call
for expanded government demand. The production efficiency findings also
are indicative of potential problems. Though not proven by the data, it
is possible that the higher labor intensity of government suppliers may
account for the higher cost of sales ratio. Equally troublesome is the

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notion that government suppliers may not be committing sufficient funds
to increase and improve their capital stock.

As interesting and important as these findings are, it must be
emphasized that they are _tentative_ conclusions based on consolidated
corporation data. These findings are re-examined in Phase II because of
two major limitations. First, the Phase I analysis dealt exclusively
with the firm as a consolidated corporation. Most corporations consist
of several parts or segments and government business tends to be concentrated
in particular segments. The point, then, is to undertake the analysis
in terms of corporate segments rather than consolidated corporations.

The second limitation of Phase I concerns a relatively loose definition
of the defense industry. In Phase I defense suppliers are distinguished
in terms of sales to the government, sales which may or may not be truly
purchases by the Department of Defense. In Phase II an aerospace emphasis
is developed and Department of Defense sources are used to determine
actual sales to the Air Force.

B. PHASE II RESEARCH OBJECTIVES

The underlying objective of Phase II research is to provide information
which will aid the Air Force in its acquisition process, both for major
weapons systems and for follow-on acquisition of parts and supplies for
the repair and maintenance of major systems. The specific objectives of
this research are to:

1) identify the total industrial base and the defense industrial
    base for Air Force acquisition;

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2) develop a cross-product index to relate products, systems, and components to consolidated corporations and to corporate segments;

3) analyze and contrast defense suppliers and corresponding non-defense firms on the basis of financial, managerial, and accounting information; and

4) evaluate how well firms and segments are able to react to inflation.

It is appropriate at this point to indicate the organization of this report. Chapter II is a description and analysis of the data. The data discussion involves a number of issues including the need to use public data sources; the nature of the COMPUSTAT data sources; the procedures used to identify appropriate aerospace segments; and the need for a cross-product index. Chapter III may be loosely defined as a methodology discussion and contains three themes. The first involves a listing and discussion of the major research questions. The second considers the analytical techniques necessary to answer these research questions. The third is the relationship between the completed research and the specific activities detailed in the Statement of Work.

Chapters IV, V, and VI represent the main analytical sections of this final report. They deal, respectively, with profitability, efficiency, and capital management aspects of firm behavior. Chapter VII is also an analytical chapter but uses a much smaller sample of firms in examining questions of efficiency and product specialization. Chapter VIII summarizes the conclusions of the Phase II analysis, compares these conclusions to those drawn in Phase I, and offers some suggestions regarding future research.

The completed analysis contains a number of assumptions and limitations and it is useful to list them here. Among the more important are the following:

1. The evaluation of the "defense industry" is accomplished only in a relative financial manner, that is, there is no attempt to assess the physical ability of firms to produce military hardware.

2. The analysis, for reasons of data limitations to be discussed later, is limited to the years of 1977, 1978, and 1979.

3. The analysis only includes public firms.

4. It is assumed that the universe of domestic aerospace firms in each of the three years was captured by the Manufacturer and Subcontractors sections of the 1980 World Aviation Directory.

5. The behavior of firms is adequately represented by the explanatory variables included in the regression analysis.

CHAPTER II. THE DATA

The purpose of this chapter is to explain why public data sources were used, the nature of the public data, and the way in which the data were organized for this study. This discussion will serve several ends. First, it will indicate to the reader the extent to which the data may be considered reliable. It is believed that the data employed here are relatively accurate and as secondary data appear consistent both between firms and over time. Second, the discussion will reveal the limits to the analysis imposed by the data. As is usually the case whether the data are from primary or secondary sources, they are never all the researcher would like them to be. Consequently not all questions can be addressed, and only indirect answers can be offered for others. The reliance on public sources is discussed first.

A. PUBLIC DATA SOURCES

A key aspect of both Phase I and Phase II is that the firm evaluation section--the empirical analysis--relies on data from public sources. This reliance on public sources develops for several different reasons.

(i) If public data sources are employed, then the number of firms--both defense suppliers and non-defense suppliers--can be maximized. Increasing sample size in this way increases confidence in the results

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generated by the statistical analysis.

(ii) The use of public data sources ensures an independent inter-
pretation and evaluation of elementary data items. As a consequence,
the possibility of bias in the construction of the data set is reduced.

(iii) Public data sources are concerned with standardization in
definitions and presentations. Given this standardization, there should
be comparability in data items between units at a point in time as well
as for the same unit over time.

(iv) The use of public data sources will allow for the periodic
updating of the analysis. Such updating may be necessary as changes in
the acquisition environment occur, and this will be the case whether the
changes arise because of new acquisition policies or because of changes
in the structure and performance of the economy.

(v) Perhaps most important is the fact that the use of public data
sources facilitates replication. In a scientific context, replication
is paramount because results must be reproducible by others before they
can be fully accepted. The notion of replicability extends, however,
beyond mere duplication and involves improvements in the analysis. Here
researchers can build upon prior work and concentrate their energies not
on data collection, but on the use of more advanced theoretical and
empirical constructs.

(vi) The collection of raw data, its processing and verification,
are all expensive. Accessing data from public sources is appropriate,
both in terms of the reasons already given and because it will allow
more cost effective application of the analytical tools.

B. THE COMPUSTAT DATA

The COMPUSTAT data provide the bulk of the information for all the statistical analysis undertaken in connection with both Phase I and Phase II. The COMPUSTAT data are available from Standard and Poors' COMPUSTAT Services Inc. and consist of a number of computer readable libraries of financial, statistical, and market information covering several thousand industrial and non-industrial companies. The information contained in this data base reflect both balance sheet and income statement items as well as a large number of other items.

One characteristic of the COMPUSTAT data which has made it usable in both Phase I and Phase II research is the standardization of definitions which ensures comparability of items both between firms and over time. These standardized definitions have been written by the company itself in cooperation with the Financial Accounting Standards Board (FASB), the American Institute of Certified Public Accountants (AICPA) and in consultation with leading accounting firms.

There are two additional characteristics of the COMPUSTAT data that make it a most desirable data base. First, each piece of information in the data set is identified by a unique company identification number and company name so that it is relatively easy to access either all of the information for one company, one specific piece of information for one company, or one specific piece of information for selected companies. Second, each company is identified with its appropriate SIC code. Thus, corporations or segments may be grouped and examined on the basis of one, two, three, or four digit SIC classifications.

The question of data reliability is important to the validity of

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the study. COMPUSTAT Services Inc. is rigorous in its data collection
and verification. It collects raw data using a multiple number of pri-
mary sources. These sources include the quarterly and annual reports of
the various companies, direct company contacts via telephone, the In-
vestment Statistics Laboratory monthly reports, the National Association
of Security Dealers automated quotations, the Securities and Exchange
Commission (SEC) reports, and related sources. This information is
given to statistical accountants who interpret the source documents and
enter the data on appropriate input sheets. These input sheets are
designed to provide a complete balancing model for the income statement
and the balance sheet for each company. From these sheets, the infor-
mation is then key punched.

Three processes are used to validate the data. The first is a
"spot" check of certain data items with the original source documents.
The second validity check involves computer generated reports. For
instance, a ten or twenty year series for a consolidated corporation
with an average change of nine to eleven percent, but with one or two
yearly entries reflecting a twenty percent change, would merit review.
The variant data would be examined to determine whether an error exists.
If it represents an error it is corrected; if not, the variation would
be footnoted as to cause. With the third type of validity check, the
computer executes a series of tests on the data. Messages are provided
if any of the data points fall beyond the bounds of indicated values.
These variations are also evaluated. Overall, these validity procedures
offer protection against two of the three main categories of error which
might arise in constructing this data base: omission or double-counting
of data sources and errors caused by inconsistent treatment of infor-

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mation between companies or between time periods. The third type of
error, judgemental error, is substantially reduced by the continuous
checking procedures. The data sources and methodology also provide for
consistent treatment of conditions where, for instance, a company acquires
a subsidary in the middle of an accounting period. When this occurs, a
restatement of overall earning is necessary for the prior quarter.

There are two different COMPUSTAT data files. The first which was
used for the Phase I research is the COMPUSTAT Annual Industrial File.
The file contains information for consolidated corporations but not for
corporate segments. The data extend for a twenty year period with the
addition and deletion of one year each October when the entire file is
updated.

The second COMPUSTAT data file is the Business Information File or
Segment File which provides information on each operating segment of a
consolidated corporation and is the basic data source for the Phase II
research. The Business Information File provides data for all of the
segments of all of the corporations represented in the industrial file
plus a number of additional corporations and their segments.

The time period covered by the Segment File extends from 1974   through
1980 for the segments of each corporation. However, the regulations
requiring detailed segment information were not issued until 1976, and
so the more detailed and more reliable information extends only from
1977 through 1980. In this study, the segment data are available only
for 1977, 1978, and 1979. In addition, as of 1977, the FASB—the non-
government accounting rule-making body—has also prescribed rules for
segment data disclosure in the annual financial reports of business

firms. Generally if revenue, profit, and/or identifiable assets of any component of a given firm (i.e., any subdivision of the firm offering an identifiable product or service) is ten percent or more of total revenue, profit, and/or assets of the given firm, certain data must be reported for that segment.

The data items presented for corporate segments, as might be expected, are not nearly as comprehensive as the data items reported for the consolidated corporation. There are five data items which are presently reported for almost all corporate segments: net sales, operating income (net profit), depreciation, capital expenditures, and identifiable assets. There is a set of six additional data items which are available for some of the segments. These items include equity in earnings of unconsolidated subsidiaries, investment in equity, number of employees, order backlog, customer-sponsored research and development, and company-sponsored research and development.

It is clear in comparing the COMPUSTAT Industrial File with the COMPUSTAT Business Information File that the latter file extends for a much shorter time period and for a very limited number of variables. Because this latter and more limited file is the major data base for Phase II research, the empirical analysis of Phase II must be more restricted than that of Phase I. This more limited scope is a tradeoff which must be made in the process of shifting the focus of the analysis from the less useful consolidated corporation to the more relevant corporate segment.

C. DISCLOSURE, INC. DATA (SEC FORM 10K)

The basic deficiency in the COMPUSTAT data is its lack of information regarding the corporate segment's sales to the Federal government and the Air Force. To remedy this deficiency additional data sources were employed.

Disclosure, Inc. is a private firm which specializes in the collection and preparation of files containing financial information for business firms in the U.S. For each year two files are available. One file contains all annual report data for each firm. The second file contains all Securities and Exchange Commission (SEC) Form 10K data. Unlike the COMPUSTAT data which were available on computer tapes, the Disclosure, Inc. files were only available on microfiche transparencies at the time of the research. They have since become available on computer tapes. Consequently, before the information in the Disclosure, Inc. files could be analyzed using the computer, the microfiche information had to be transferred to the computer--a very time consuming and labor-intensive activity.

For the purposes of Phase II research the second file, the SEC Form 10K File, is of particular concern. The SEC Form 10K is the annual financial reporting form prescribed by the SEC for most of its 12,000 registered companies. Governed by regulations S-X and S-K, disclosure requirements include but are not limited to the following kinds of information: (i) information about the properties of the business, its securities and securities holdings; (ii) a summary of operations which is basically a summary of earnings; (iii) financial statements such as balance sheet and income and funds statements; (iv) legal proceedings; and (v) industry segments and lines of business. This Disclosure, Inc.

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file then is a much broader file which includes all the information in the first, annual report file.

The Disclosure, Inc. SEC Form 10K file was used to supplement the COMPUSTAT Business Information File. For selected firms and firm segments, the Disclosure, Inc. SEC Form 10K files for 1977, 1978, 1979, and 1980 were examined and data obtained regarding the percent of consolidated company revenues accounted for by the segment, and the dollar value of segment sales to the government. These data items were then placed into computer readable form, usable with the COMPUSTAT data.

Unfortunately the combined information available from the COMPUSTAT Business Information File and the Disclosure, Inc. SEC Form 10K data did not allow determination of a firm's sales to the U.S. military establishment. Thus, it was necessary to utilize a third source to more precisely determine the extent to which a corporate segment was involved with Air Force sales. This third source was the Individual Contract Action Reports (Department of Defense Form 350). This information for Air Force contractors was made available through the Business Research Management Center at Wright-Patterson Air Force Base. Although the DD Form 350 must be completed for all contract actions over $10,000 in the DOD and includes a variety of data, the specific information obtained was limited to three items: the name of the contractor, the date of the contract, and the value of the contract (for this report contract modifications were ignored and only the initial contract amount was used). This information was for calendar years 1977, 1978, and 1979. Using the name of the contractor as the identifying factor, the value of the contract as specified in the DD Form 350 was then added to the merged COMPUSTAT Business Information File and the Disclosure, Inc. SEC Form 10K data. This variable is hereafter identified as Air Force sales.

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As a final point it should be noted that an additional data source was explored as well: business information files prepared by Economic Information Systems, Inc. These files provide information at the plant level and it was hoped that this plant specific information could be systematically related to the corporate segment information. However, there was no way in which the plants could be reliably identified as a part of a particular corporate segment and, therefore, this plant specific information could not be used.

D. IDENTIFYING THE AEROSPACE INDUSTRIAL BASE

As mentioned previously, one of the objectives of the current Phase II research is to focus the analysis more specifically on that part of U.S. industry which is most germane to the Air Force; that is, to concentrate the analysis on the U.S. aerospace industry. In effect, the problem is to select from the COMPUSTAT Business Information or Segment File as supplemented by the data from the Disclosure, Inc. SEC Form 10K File and the DD Form 350 those companies and segments which produce aerospace products. Once the aerospace industrial base is defined, firms and segments can be classified as Government/Air Force suppliers and non-Government/Defense suppliers and the questions regarding differences in behavior can be addressed.

The basic reference for the selection of aerospace consolidated corporations and corporate segments is the 1980 World Aviation Directory (WAD), published by the Ziff-Davis Publishing Company, Washington, D.C. The WAD is the most comprehensive directory available on the composition of the aerospace industry.

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The WAD offers several different classifications of aerospace firms. The one which is most inclusive and most relevant for present purposes is the list of "manufacturers" and "subcontractors." As defined by the WAD, manufacturers are identifiable consolidated corporations and segments of consolidated corporations which produce completed aerospace and/or missile systems for foreign or domestic, civilian or military markets. Boeing and General Dynamics are examples. Subcontractors are firms which produce "products, components, and subassemblies." Clearly, the WAD distinguishes between manufacturers and subcontractors by the type of product they produce rather than by firm size, level of technology, or the contractual relationship between the firm and the economic units which purchase its product. Because of this output criterion, it is useful to detail the definitions of the kinds of output or products:

(i) A product is the most basic element produced by subcontractors, elements which are subsequently used in the production of components, subassemblies, or systems. Examples include semiconductors, flexible tubing, cable, and fasteners.

(ii) A component is the next most basic element consisting, presumably, of two or more parts. Examples of this type of subcontractor output include the base for a radio, a portion of an avionics computer, or the set of attachments and flexible tubing for a fuel cell.

(iii) A subassembly is the third type of output produced by a subcontractor and can be viewed as an output which includes something beyond a component--a component plus a part or the union of two components. Thus, the term subassembly is often used to refer to a major portion of a system but not the complete system. Examples are an aircraft's landing gear or ejection seat.

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(iv) A system is a stand-alone item produced by a manufacturer. The F-15 aircraft and the Air Launched Cruise Missile are examples.

It is important to recognize that the Air Force purchases output from some firms that are not listed in the WAD. These firms can be identified from the DD Form 350 data and were included in the analysis. The number of such firms was limited.

With the exception just noted, the aerospace industrial base is defined as the sum of all subcontractors and manufacturers as specified by the WAD. While the WAD specifies the aerospace industry, the financial information necessary for the analysis is contained in the COM-PUSTAT Business Information File, the Disclosure, Inc. SEC Form 10K file and the DD Form 350. But the WAD includes both public and private firms while the COMPUSTAT and SEC Form 10K information relate only to public firms. Thus, the basic data set which is analyzed includes only public firms in the aerospace industry.

Figure 1 is an attempt to show schematically the industrial framework for this study. The first distinction between the U.S. industrial base and the U.S. aerospace industrial base is determined by the WAD. The second distinction between the U.S. aerospace industrial base and that portion which consists of public firms is determined by the COM-PUSTAT Business Information file and the Disclosure, Inc. SEC Form 10K file. The final distinction involves a determination of those public firms with Air Force sales, a determination made on the basis of the DD Form 350. The analysis of private firms, many of whom appear to be small business, would require still other data sources and are not included in this study.

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Figure I
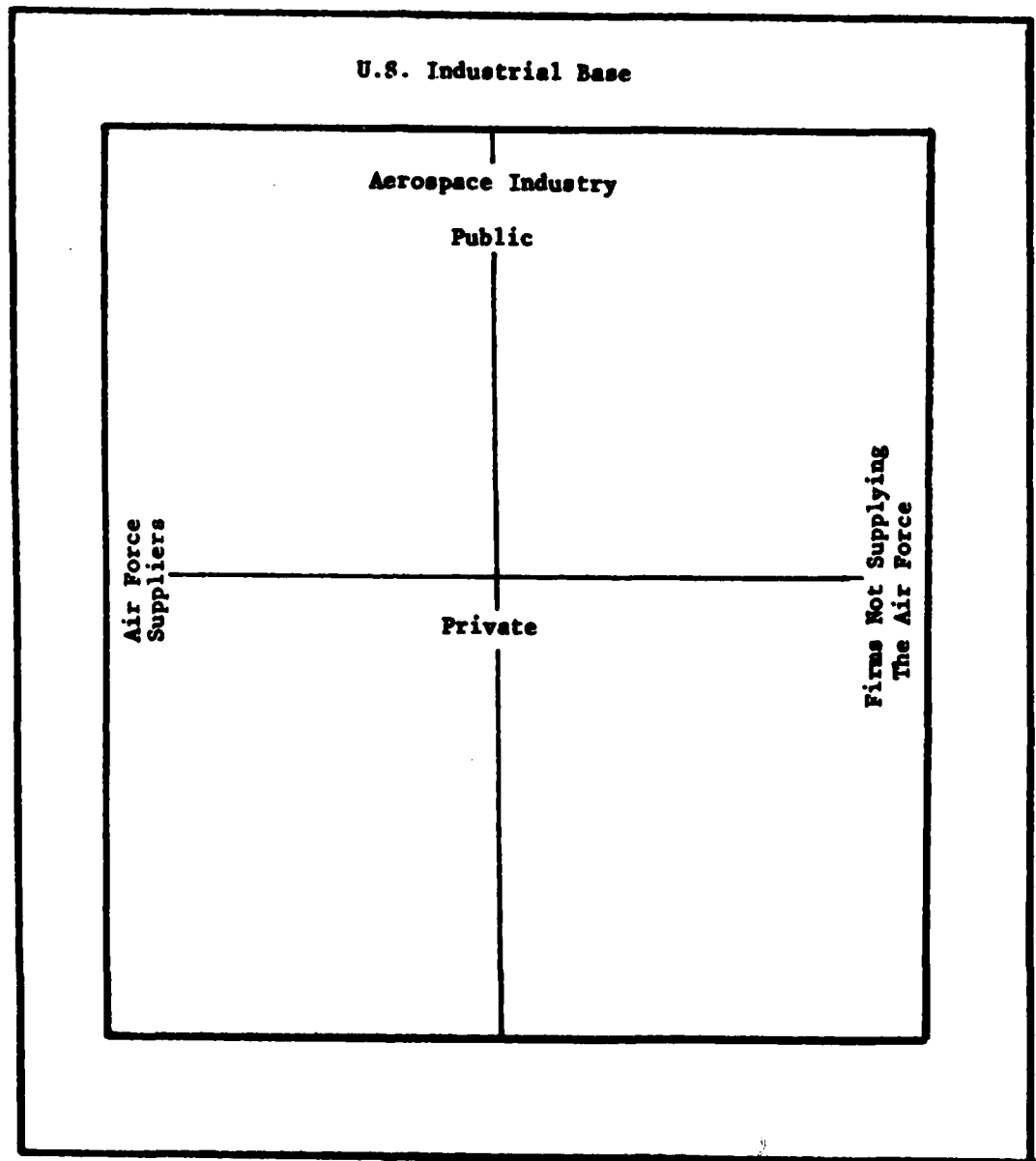
E. THE CROSS-PRODUCT INDEX

The Cross-Product Index was developed to facilitate an understand-
ing of the nature of the firms in the Defense Industrial Base and as an
aid to the acquisition process of the Air Force (as identified in the
STATEMENT OF WORK for this contract). This discussion will highlight
the nature of the index and describe how it was used and how it might be
used in the acquisition process. A more complete description regarding
the design and operation of the cross-product index is presented in a
separate technical summary called "A Cross-Product Index for the Aero-
space Industry."

The Cross-Product Index is a computer operated information re-
trieval system. While the principles of operation do not require com-
puter use, it was implemented on the computer for use as a part of this
contract. The system could be used as a manual system or directly from
the WAD publication. Using the computer the data set can be manipulated
to gain a more complete understanding of the nature of the aerospace
industrial base and the description and scope of products contained
therein: Products, Components, and Subassemblies. The value of the
Cross-Product Index is that it defines precisely the nature of the vari-
ous types of items produced by the various companies. By using the
entry for an identified product one can obtain the names of all of the
companies that produce it. In effect, the Cross-Product Index functions
as a computerized source list. It is also possible to reverse the pro-
cess and to determine all the products manufactured by a particular
company.

Perhaps more important than the simple identification of products

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and firms is the ability to move from the Cross-Product Index to the expanded COMPUSTAT data files. An analyst could use the Cross-Product Index to obtain a listing of firms that produced a particular product. Using this list, financial information on each of the producers could be obtained. For analytical purposes, one could quickly determine the number of firms producing the product, the extent to which each of them dealt with the government, and the financial condition of each. This same information is obviously beneficial in both acquisition and planning for contract negotiation. In short, by using the Cross-Product Index in conjunction with the expanded COMPUSTAT data files, both research and acquisition can proceed much more quickly with much greater information.

It is also important to note that the Cross-Product Index also provides useful information regarding the structure of the U.S. aerospace industrial base. For example, operating in a purely descriptive fashion, the Cross-Product Index can be used to determine the number of firms capable of producing particular products. In a crude way this can be interpreted as a measure of the potential industrial capacity existent in the economy relative to that product. Operating in a company context the Cross-Product Index can provide information regarding the diversity of companies; that is, the range of products they produce. This type of descriptive analysis is excluded from the Phase II report because it can be more specifically and easily done by persons utilizing the Cross-Product Index.

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F. THE CONTROL DATA SET

With all of this information as background, the specifics of the
data employed in the analytical sections of this study can be properly
identified. For 1977 the sample includes 350 public firms and these
firms represent 1165 segments. For 1978 there were 361 public firms
inclusive of 1241 segments and for 1979 there were 363 public firms
inclusive of 1251 segments (see Appendix B for a listing of all the
consolidated corporations included in the analysis). A segment becomes
a part of the analysis if it is specifically identified in the WAD or in
the DD Form 350, or the segment of a firm so identified. For each of
these segments the COMPUSTAT Business Information File, the Disclosure,
Inc. SEC Form 10K file and the DD Form 350 file provide the following
data items: net sales, operating income, (calculated cost of goods
sold), depreciation, capital expenditures, identifiable assets, percent
of consolidated company revenues accounted for by the segment, the dol-
lar value of segment sales to the government (if any), the dollar value
of segment sales to the Air Force (if any), and the status as manufac-
turer or subcontractor as identified by the WAD. In addition, for some
of these segments, additional data are available including equity on
earnings of unconsolidated subsidiaries, investment in equity, number of
employees, order backlog, customer-sponsored research and development,
and company sponsored research and development.

Some deficiencies do exist in the data. The first has already been
noted and involves an inability to include all firms, both public and
private in the analysis. The difficulty here is that there is no sys-
tematic way of evaluating the bias created by the necessary exclusion of

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private firms.

A second problem involves the fact that only the 1980 WAD was used (data included for calendar year 1979). A firm included in the 1979 WAD (for calendar 1978) but not in the 1980 WAD is excluded. The restriction was simply a function of the time and effort necessary to treat each edition of the WAD separately. Our impression is that this is not a serious problem.

G. SUMMARY

This data chapter provides information regarding the data sources and identified as precisely as possible the kinds of firms being analyzed. The three data sources are the COMPUSTAT Business Information File, the Disclosure Inc. SEC Form 10K file, and the Individual Contract Action Report DD Form 350. The firms included in the analysis are public aerospace manufacturers and subcontractors as identified by the WAD. The analysis now turns to question of differences in behavior of the firms (performance of firms) as determined by government and Air Force sales.

CHAPTER III.   RESEARCH QUESTIONS AND METHODOLOGIES: AN OVERVIEW

This chapter identifies and discusses in a systematic and general fashion the research questions which are raised in subsequent chapters and the methodologies used in answering these questions. A separate chapter of this nature is useful for several reasons. First, it allows for a comparison of the Phase I and Phase II research questions and methodologies showing in particular the way in which the Phase II data constraints lead to limits on the Phase II questions. Second, it provides an opportunity to indicate how the research methodologies have been changed and improved. Third, it allows for a discussion of the relationship between research questions and the overall objectives of Phase II. By treating each of these points in a separate chapter, the actual analysis of subsequent chapters can be presented without tangential discussion.

A.   PHASE I AND PHASE II RESEARCH QUESTIONS

In a sense Phase II can be considered as a replication of Phase I with Phase II involving a more important unit of analysis (the corporate segment) and a more precise definition of the U.S. aerospace industrial base. With this interpretation of Phase II the expectation is of an evaluation of the impact of sales to the government or the Air Force in five areas of firm behavior: (i) corporate liquidity and working capital management, (ii) profitability, (iii) production efficiency, (iv) inflation reaction, and (v) product specialization. However, given the

more limited data base available for the Phase II research, the number
and scope of areas must be reduced.

The first area of firm behavior from Phase I which is examined in
Phase II is that of profitability. The major research question for this
area is:

> What is the impact of sales to the government and the Air
> Force on the profitability of corporate segments in the aero-
> space industry?

In addressing the issue of profitability, the Phase II data base con-
tains or allows for the construction of two measures of profits: return
on investment (ratio of operating profits to identifiable assets) and
the profit margin ratio (operating profits divided by net sales). In
Phase I the scope of the profitability analysis was somewhat broader for
it included these two and two additional measures: return on equity and
the price earnings ratio. These last two measures may have little mean-
ing at the segment level because the value of equity and the sale price
of common stock are affected by the performance of the consolidated
corporation which may not be similar to that of the particular corporate
segment.

The second area of firm behavior is that of efficiency. The major
research question here is:

> What is the impact of sales to the government and the Air
> Force on the efficiency of corporate segments in the aerospace
> industry?

As for measures of efficiency only two of the four used in the Phase I
research are available from the Phase II control data set. The available
measures are the cost of sales ratio (the difference between net sales
and operating profits divided by net sales) and the capital-output ratio
(identifiable assets divided by net sales). The two measures used in
Phase I but not in Phase II are the capital-labor ratio and

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the labor-output ratio. In this case both ratios would have provided interesting information regarding segment behavior and thus the reduction in scope for the Phase II efficiency analysis represents a true loss; however, an analysis of the labor-output ratio is, as will be explained, presented in Chapter VII for a limited number of firms.

The final area of firm behavior examined involves corporate liquidity and capital management. In this instance the available data do not allow for consistency between Phase I and Phase II. That is, none of the Phase I measures of corporate liquidity and capital management are available from the Phase II data base. However, three new measures can be used instead. The three new measures are:

1. the gross replacement ratio (capital expenditures divided by identifiable assets),

2. the net replacement ratio (the difference between capital expenditures and depreciation divided by identifiable assets), and

3. the capital change ratio (capital expenditures divided by depreciation).

Although these ratios are new, their meaning, interpretation, and importance are fairly obvious because they deal with productive-capacity preservation. Thus, in moving to corporate segments, information regarding liquidity management is lost but with the new segment ratios the analysis of capital management is enhanced. For this reason the research question for this area ignores liquidity management and focuses on capital management and may be stated as:

> What is the impact of sales to the government and the Air Force on the capital management of corporate segments in the aerospace industry?

As for the other two areas of firm behavior examined in Phase I -
product specialization and inflation reaction - the Phase II control
data set permits no systematic analysis. It does permit some analysis
for a limited number of corporate segments but because of a substantial
decrease in the number of firms and a variablity in the number of firms
in moving from measure to measure this investigation is restricted to
Chapter VII.

So as it stands the main Phase II analysis extends to only three of
the five Phase I areas. For the first of these areas - profitability -
the scope of analysis is all that can be expected and there is no real
loss of information. For the efficiency area limiting the scope of the
analysis to two ratios involves a real loss of information. For the
third area the loss in information regarding liquidity management is
balanced by more information regarding capital management and in this
sense there is no net loss of information.

In comparing Phase I and Phase II from an overall perspective,
there is a loss of information; the analysis is more limited because of
data constraints. But it must be remembered that there is compensation
for this loss of information. Phase II involves a more appropriate unit
of analysis, the corporate segment rather than the consolidated corpora-
tion. Phase II employs a more precise definition of the aerospace in-
dustrial base. Phase II allows for the distinction between government
sales and Air Force sales. Indeed, the last advantage means that there
can be two versions of each major research question, one phrased in
terms of government sales and the other phrased in terms of Air Force
sales.

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B. PHASE I AND PHASE II METHODOLOGIES

In Phase I two different methodologies were employed in attempting
to determine the impact of government sales on the five areas of con-
solidated corporation behavior. One methodology or approach, involved a
modified means test. With this approach the consolidated corporations
were divided into two groups: those that had government sales equal to
or greater than 13 percent of total sales (primes) and those that had
government sales less than 13 percent of total sales (controls). The
average or mean on a particular measure of firm behavior of one group
was then compared to the average on that measure for the other group.
The other methodology or approach involved the use of stepwise regres-
sion procedures. Here the particular measure of firm behavior became
the dependent variable while the percent of total sales which the firm
made to the government became the key independent variable. The other
independent variables at the beginning of the stepwise procedures in-
cluded three size variables, three efficiency variables, and one factor
mix variable. Other independent variables were added from time to time
depending on the area of firm behavior being examined and on the measure
deployed as the dependent variable.

In the examination of corporate segments both of these methodolo-
gies will, in general, be employed in examining the three major research
questions. However, there are a sufficient number of modifications to
each methodology to warrant a more detailed discussion. Each methodolo-
gy is discussed in turn.

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1. Comparisons of Average Behavior

The first step in this analytical process is to divide the corporate segments into groups. Rather than using the 13 percent division employed by Phase I or some other arbitrary figure, it was decided that an "extreme group" division might provide a more rigorous test. Included in one group were all the firms with no (or zero percent) sales to the government (and the Air Force). In the other groups were all the firms which had sales to the government (and the Air Force) in an amount equal to or greater than 75 percent of total sales. This extreme group division ignores all corporate segments which do not fit into one of the two categories, yet it is clear that for the former group government (and Air Force) sales are unimportant while for the latter group government (and Air Force) sales are very important. But the group with zero percent sales is also compared to two other groups: those with government (and Air Force) sales equal to or greater than 50 percent of total sales and those with government (and Air Force) sales equal to or greater than 25 percent of total sales. In effect then there are three pairwise comparisons with the base group being firms with zero government (and Air Force) sales.

Having established the three pairs, the second step in the process is to calculate the mean value for a particular ratio for each of the groups. For example, if the major research question of profitability is being addressed, the mean value of the profit margin ratio would be calculated for each of the groups.

The third step in the process is to test the hypothesis that the mean values of the ratio for groups in pairwise fashion are equal. This

is accomplished using the "t statistic." (The actual computations involve the T TEST Procedure in the Statistical Analysis System software package). Thus, for each ratio the probability that the mean values for the two groups in the pair are equal is calculated.

In comparing this methodology as applied in Phase I and in Phase II, the Phase II specifics embody two advantages. The first advantage is that the division or grouping of firms is somewhat less arbitrary. The second advantage is that the comparison between groups is accomplished in a statistically more rigorous manner.

2. Regression Analysis

Although the comparison of average behavior allows the determination of whether a significant difference exists between the two groups of firms in the pair with respect to a particular ratio, it does not allow for a conclusion as to why a detected difference exists. Even though the average behavior analysis is improved in Phase II, regression analysis is as necessary in Phase II as it was in Phase I. But again the attempt is made to improve this particular methodology as it is employed in Phase II. The nature of the improvements is best understood by reexamining how the regression analysis was used in Phase I.

In Phase I the various measures from the five areas of firm behavior were employed as the dependent variables. As the results showed, certain regression statistics could be changed dramatically by using level values (aggregate dollar volume) rather than ratio values. To bypass this artificality all the dependent variables used in Phase II will be of a ratio form.

In Phase I the independent variables were divided into macro and

micro categories. The macro variables were so named because they appeared at the beginning of each stepwise regression while the micro variables were not utilized in such a systematic fashion.

There were eight macro variables: one represented the percent of the firm's total sales accounted for by government sales; three variables represented size measures - net plant, net sales, and number of employees; three variables represented efficiency measures - cost of goods sold ratio, capital-output ratio, and labor-output ratio; and the remaining varible, the capital-labor ratio, was included to control for differences in factor mix between firms. The micro variables were added to particular regressions when warranted on the basis of prior theoretical and/or empirical considerations. As the stepwise procedures were executed certain macro and micro variables were deleted for they did not contribute to the overall explanation of a particular dependent variable in a statistically significant manner.

As for the Phase II regression analysis, the control data set not only limits the number of dependent variables to be examined (two profitability ratios, two efficiency ratios, and three capital management ratios), it also limits the number of independent variables. From the list of macro independent variables used in Phase I, five are available in Phase II: percent of the firm's total sales accounted for by government (and Air Force) sales, identifiable assets (equivalent in an approximate manner to net plant), net sales, cost of goods sold ratio, and capital-output ratio. The first variable is, of course, the key variable: the size, sign, and statistical significance of this variable determine conclusions with respect to the major research questions.

It is important to note that the thrust of the regression analysis

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is not to assess the ability of a theoretical model to explain empirically some aspect of firm behavior. Rather, the appropriate interpretation of the regression analysis is to determine the impact of government (and Air Force) sales on some aspect of firm behavior while controlling for certain other differences between firms. With this appropriate interpretation the emphasis is not on the coefficient of determination. This statistic is expected to be low given the cross sectional nature of the data, the ratio form of the dependent variables, and the limited number and scope of the independent variables.

Net sales, identifiable assets, the costs of goods sold ratio, and the capital-output ratio are all used as independent variables. One variable not utilized in the Phase I regression analysis is used in Phase II and is designed to capture the WAD distinction between manufacturers and subcontractors. The basic regression equation thus appears as:

$$DV_i^j \quad = \quad f(GSL_i, NSALE_i, ASSET_i, COS_i, COR_i, WAD_i)$$

where:

DV_i^j = one of the seven dependent variable ratios for the ith firm;

GSL_i = percent of the ith firm's total sales accounted for by government sales (note--this variable becomes DSL when the focus shifts from government sales to Air Force sales);

$NSALE_i$ = net sales of the ith firm;

$ASSET_i$ = identifiable assets of the ith firm;

COS_i = cost of goods sold ratio for the ith firm;

COR_i = capital-output ratio of the ith firm; and

WAD_i = the WAD classification for the ith firm with 0 for WAD listed subcontractors and 1 for WAD listed manufacturers.

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A summary of all the variables used in the empirical analysis, the symbols employed to represent these variables, and the definitions of the variables is presented in Appendix A.

It should be noted that given the limited number of independent variables available for Phase II, stepwise regression procedures are not employed.

As described there are only two relatively minor advantages associated with the regression analysis used in Phase II; both pertain to an ease of interpretation rather than an increase in statistical robustness. First, there is greater consistency in the basic regression equation in moving between dependent variables. In this sense there is a set of macro variables but no set of micro variables. Second, by not utilizing the stepwise procedures the impact of each macro variable in each regression can be evaluated more systematically.

Finally, it should be mentioned that the list of macro variables corresponds in a broad sense to the controls established for Phase I. That is, the impact of GSL (and DSL) on the dependent variable is determined while controlling for differences in the size of firms (NSALE and ASSET) and the efficiency of firms (COS and COR). The loss of the factor mix control utilized in Phase I is partially compensated for by the use of the WAD distinction between manufacturers and subcontractors.

C. RESEARCH QUESTIONS AND THE STATEMENT OF WORK

The Statement of Work lists seven specific tasks to be completed by the current research. Each of these will be listed and the manner in which each is fulfilled and the section of the report describing each

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task will be referenced:

1. Identify companies or segments with their appropriate operating subsidiaries and/or segments doing business with the Government/Air Force.

This task was viewed as a preliminary yet essential activity. As detailed in Chapter II, it was possible to identify segments doing business with both the government and the Air Force. In this instance the scope of the search was limited to the aerospace industry as defined by the WAD and public firms. It was also possible to distinguish between manufacturers and subcontractors as defined by the WAD.

2. Establish a control group of segments for preliminary and revised modeling.

In essence a control corporate segment is a segment which is not involved with government or Air Force sales, or as described here a base group. This group of firms is constructed and is compared to those firms which are extensively involved with government and Air Force sales. These comparisons are the average behavior comparisons presented in subsequent chapters.

3. Establish a prime contractor group of segments for preliminary and revised modeling.

In this instance the term prime refers to firms that are extensively involved with government and Air Force sales. In Phase I the term extensive was defined as those consolidated corporations with sales equal to or greater than 13 percent of total sales. For Phase II corporate segments are examined and the percent is variable: 25 percent, 50 percent, and 75 percent. These firms are then contrasted to those firms defined as controls (the base group) in item 2 above. Because the titles "controls" and "primes" have multiple meanings in the area of

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defense contracting, they have not been used in this report except in reference to the Phase I research.

4. Establish a secondary group of segments for preliminary and revised modeling.

The immediate purpose of this task was to create a distinction between those firms which deal directly with the government (prime contractors in the conventional sense) and those firms which are used by the first group of firms in fulfilling their government and defense contracts (subcontractors in the conventional sense). The nature of the data preclude the completion of this item. Simply, from the available public data sources there is no way to determine whether a firm is a subcontractor to another firm on a government or defense contract. However, an attempt is made to establish a so-called secondary group on other grounds. The distinction between manufacturers and subcontractors as defined by the WAD is incorporated into the regression analysis. The WAD definition of subcontractors, as the discussion in Chapter II more fully indicates, includes those firms that produce parts, components, and subassemblies as distinct from those firms that produce systems. In order to avoid confusion, the reference will be to WAD subcontractors when that interpretation is being employed.

5. Statistically describe and evaluate the firms and segments falling into the categories above. The description will include cost of sales ratios, labor-output ratios, order backlogs, research and the like.

This is the major task in the Phase II research. As indicated earlier in this chapter only seven ratios will be examined for the public firm segments identified by WAD as either manufacturers or subcontractors. This restriction is imposed by the nature of available data. Additional data are available for a smaller number of firms which

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do allow for a broader analysis. In effect there are two samples of firms. One sample is quite large and consistent between data items. This sample is used in Chapters IV, V, and VI. The other sample is much smaller and varies in size from item to item and for these reasons use of this sample is confined to Chapter VII. Between the analysis based on the large sample and that based on the smaller sample, the scope of Phase II is comparable to Phase I. As for the evaluation of firms, it involves both the comparisons of average behavior and regression analysis.

6.   Revise and establish a product-line cross index by corporate entity or operating segment, and by product line.

This item was included because it was believed that the computerized Cross-Product Index would be a useful aid to Air Force personnel actually acquiring goods particularly when used in conjunction with the financial information available on the COMPUSTAT Business Information File. A description of the design and operation of the Cross-Product Index is presented in a separate report entitled "A Cross-Product Index for The Aerospace Industry." At one point consideration was given to disaggregating the analysis according to product line. However, depending on the product line chosen this could have meant an analysis limited to a very small number of firms producing a particular product and would have involved an extremely lengthy analysis if extended to cover each individual product. As a consequence the analysis of firm behavior as presented in subsequent chapters is not disaggregated by product lines.

7.   Each of the product line segments will be examined
      (i)   to determine the industrial base for that product line;
      (ii)   to look at the financial and accounting history of segments in that product line;
      (iii) to undertake regression analysis (hypothesis testing) as appropriete on segment behavior for companies or segments (as appropriate) in that and related product lines;

(iv) regression analysis will be used for the final analysis to include studies of segment behavior and to include segment reactions to inflation and/or other areas of business uncertainty as appropriate.

As indicated by the discussion of item 6 no analysis was undertaken at the product line level. Determination of the industrial base for all the WAD defined product lines can be easily obtained by simply exercising a complete print out of the computerized Cross-Product Index. Financial and accounting histories of segments within a product line are also easily obtained by selecting information from the COMPUSTAT Business Information File for those segments identified from the Cross-Product Index as producers of that particular product. Regression analysis is utilized but not at the product line level. The analysis of inflation reaction is limited given that only three years of data were available at the segment level, restricting the analysis of a problem which occurs over time.

D. SUMMARY

The purposes of this chapter were to examine as separate items the major research questions, the methodologies employed, and the relationships between this final report and the statement of work. As indicated average behavior comparisons and regression analysis are used to determine the impact of government and Air Force sales on profits, efficiency, and capital management on the segments of public firms in the aerospace industry. These analyses are presented in Chapters IV, V, and VI respectively. An analysis based on a few and variable number of segments dealing with the areas of inflation reaction and product specialization is presented in Chapter VII. As presented the entire analy-

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sis completes the research tasks with the exception that it is not con-
ducted at the product line level and the inflation reaction evaluation
receives only minor consideration. Appendix A to this report is the
glossary of variable names used in the analysis. Appendix B is an ex-
ample of corporate structure for aerospace firms. This report is con-
sistent within that framework. Appendix C lists the consolidated corporations
included in the 1979 year analysis.

CHAPTER IV. PROFITABILITY OF CORPORATE SEGMENTS IN THE AEROSPACE INDUSTRY

This is the first of four analytical chapters. It focuses on the impact of sales to the government and the Air Force on the profitability of corporate segments in the aerospace industry. As indicated by the methodology section of the preceding chapter, the evaluation includes a set of average behavior comparisons and an analysis based on regression procedures. Each is taken in turn.

A. AVERAGE BEHAVIOR COMPARISONS

With respect to profitability there are two versions of the major research question:

    (i) What is the impact of sales to the government on the profitability of corporate segments in the aerospace industry?

    (ii) What is the impact of sales to the Air Force on the profitability of corporate segments in the aerospace industry?

Table 4.1 contains information pertaining to these two questions when profitability is measured first by the profit margin ratio and then by return on investment. Consider the question of government sales and the profit margin ratio. For 1977 there is no statistical significance attached to the observed differences in average profit margin ratios for that group of firms with zero percent sales to the government and each of the comparison groups: those with 75 percent or more in sales to the government, those with 50 percent or more in sales to the government, or those with 25 percent of more in sales to the government. (Throughout

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Table 4.1

Average Behavior Comparisons: Profitability Ratios
All Firms

			Government Sales						Air Force Sales				
				Profit Margin Ratio		Return on Investment			Profit Margin Ratio		Return on Investment		
Year	Sales Percentage Comparison**	Firm Group	n	Mean	Prob.*	Mean	Prob.*	n	Mean	Prob.*	Mean	Prob.*
1977	0% vs. 75%	0% 75%	851 47	.089 .123	.39	.164 .459	.01	876 2	.088 .102	.95	.171 .305	.58
	0% vs. 50%	0% 50%	851 70	.089 .114	.44	.164 .393	.01	876 9	.088 .088	.99	.171 .250	.46
	0% vs. 25%	0% 25%	851 114	.089 .108	.47	.164 .306	.01	876 23	.088 .093	.84	.171 .254	.33
1978	0% vs. 75%	0% 75%	826 96	.102 .091	.62	.179 .266	.12	1002 5	.104 -.009	.21	.187 .004	.42
	0% vs. 50%	0% 50%	826 142	.102 .094	.67	.179 .240	.18	1002 142	.104 .046	.36	.187 .140	.77
	0% vs. 25%	0% 25%	826 199	.102 .101	.97	.179 .238	.14	1002 23	.104 .074	.48	.187 .181	.95
1979	0% vs. 75%	0% 75%	850 81	.103 .094	.66	.171 .266	.01	957 4	.105 .144	.66	.179 .379	.12
	0% vs. 50%	0% 50%	850 124	.103 .100	.86	.171 .249	.01	957 8	.105 .022	.23	.179 .233	.55
	0% vs. 25%	0% 25%	850 191	.103 .104	.87	.171 .233	.01	957 22	.105 .064	.32	.179 .211	.56

* Prob. values indicate the probabilities that the mean values are equal.
** 0% indicates firms with no sales to government or the Air Force while the other percentage indicates the percent of sales to the government or the Air Force.

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this report statistical significance is consistently interpreted at the
conventional 5 percent level; in terms of the Prob. values given in
Table 4.1, a value of .05 or less indicates statistical significance.)
It is interesting to note that the base group, the group with zero per-
cent sales to the government, has the lowest profit margin ratio. These
basic patterns hold in 1978 as well: the observed differences in profit
margin ratios between the base group and each of the comparison groups
are not statistically significant. The results for 1979 are fully con-
sistent with 1977 and 1978: there is no statistical significance asso-
ciated with the recorded different profit margin ratios.

But the results in Table 4.1 indicate that there are statistically
significant differences in profitability when return on investment is
the profit criterion. For 1977 the return on investment for the group
of firms with zero percent sales to the government is .164 while the
corresponding figure for the three comparison groups ranges from .306 to
.459. The three pairwise comparisons indicate that the higher rates of
return on investment for those firms with government sales are statis-
tically significant at the one percent probability level. As for 1978
there is a narrowing of rates of return on investment: .179 for the
base group and a range from .238 to .266 for the three comparison groups.
These differences are not statistically significant at the conventional
significance level of 5 percent. The pattern for 1979 is consistent
with the 1977 results: the pairwise comparisons indicate that the recorded
differences are statistically significant at the one percent level.

It would appear that as far as conclusions regarding differences in
profitability are concerned, they are sensitive to the measure of prof-
itability and the particular year examined. That is, there is a signif-

icant difference between the base group and the comparison groups only with respect to return on investment and then only in 1977 and 1979.

Turning to the Air Force sales comparisons, also shown in Table 4.1, the statistics reveal that regardless of the measure of profitability and regardless of the year examined the mean ratios are not signficantly different in a statistical sense. Breaking down the analysis more specifically, the profit margin ratio for 1977 for the firms with zero percent Air Force sales is .088. The ratios for the three comparison groups range from .088 for the group of firms with 50 percent or more in defense sales to .102 for the group of firms with 75 percent or more in defense sales. For 1978 the profit margin ratio for the base group is slightly higher at .104. The range for the three comparison groups is much wider and includes a negative figure. A pattern similar to 1978 is recorded in 1979 with an average profit margin ratio of .105 for the base group and a range from .022 to .144 for the three comparison groups. Aside from the lack of statistical difference in these average ratios, the other interesting feature revealed in Table 4.1 is the extreme variability on a year to year basis for a sample that consists of a limited number of firms. Clearly when the number of firms reaches a severely limited maximum of five (for the comparison group consisting of firms with 75 percent or more in Air Force sales), the average can be dramatically affected by the performance of a single firm.

As for the return on investment profitability criterion when firms are distinguished on the basis of Air Force sales, the variability on a year to year basis for the three comparison groups is again evident. In 1977 the base group's average return on investment is .171 while the

corresponding figure for the three comparison groups ranges from .250 to .305. For 1978 the average return on investment for the base group increases slightly to .187 while the average for all three comparison groups falls so that the range now is .004 to .181. In 1979 the average return on investment for the base group again varies only slightly, decreasing to .179, while the corresponding figures for all three comparison groups rise by substantial amounts. None of the pairwise comparisons for any of the years reveals any statistically significant differences.

It is useful to restate the overall conclusion: regardless of the measure of profitability and regardless of the year considered, there is no statistical difference in the average return on investment for firms with zero percent Air Force sales on one hand and firms with 25 percent or more in Air Force sales, 50 percent or more in Air Force sales, or 75 percent or more in Air Force sales.

B. REGRESSION ANALYSIS

Although the comparisons of average behavior presented in the previous section allows for the statistical evaluation of differences in profitability measures, the analysis must be considered uni-dimensional. This simply means that no other factors are considered in the comparisons besides the percent of government or Air Force sales and their relation to the particular profitability measure. A significant difference in a profitability ratio may however be due to factors such as the size of firms rather than their status as a government or Air Force supplier. Therefore, profitability must be reexamined from a multi-

dimensional perspective. This is the function of the regression analysis.

Table 4.2 presents the regression results when both measures of profitability—the profit margin ratio (PMR) and return on investment (ROI)—are used as dependent variables. As indicated in the methodology section of the preceding chapter, the explanatory variables include two efficiency variables, two size variables, and a binary variable designed to capture the WAD distinction between manufacturers and subcontractors. In the regressions presented in this chapter four variables are invariant between regressions: the capital-output ratio (COR), net sales (NSALE), identifiable assets (ASSET), and the WAD manufacturer-subcontractor distinction (WAD). One variable does change between regressions. In the PMR regressions the cost of goods sold ratio (cost of goods sold divided by net sales) cannot be used as an explanatory variable for statistical reasons. So in its place the cost of goods sold - a level or dollar value rather than a ratio - is used. To repeat, in the PMR regressions the cost of goods sold (COGS) is used as the second efficiency variable while in the ROI regressions the cost of goods sold ratio (COS) is used as the second efficiency variable.

In the regressions for government sales GSL (percent sales to government) is the critical independent variable while DSL (percent sales to Air Force) is the critical independent variable in the Air Force sales regressions. This variable represents the percent of the firm's sales which are government purchases (for GSL) and correspondingly the percent of the firm's sales which are Air Force purchases (for DSL). It is the size, sign, and significance of this variable which forms the basis for inferences regarding the impact of government and Air Force

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Table 4.2

Regression Results for Profitability Ratios*
All Firms
(Glossary of Names: Appendix A)

Sales Category	Ratio	Year	Constant	GSL	DSL	COGS/COS**	COR	NSALE	ASSET	WAD	R^2	F-RATIO	N
Government Sales	Profit Margin Ratio (PMR)	1977	.101 (.01)	.0003 (.049)	---	.27 (.04)	-.02 (.01)	.26 (.06)	.13 (.59)	.002 (.92)	.01	2.32	924
		1978	.07 (.01)	.00004 (.82)	---	-.30 (.01)	.01 (.01)	.30 (.01)	-.03 (.83)	.02 (.09)	.09	18.76	1187
		1979	.10 (.01)	-.0002 (.92)	---	-.29 (.01)	-.035 (.01)	.27 (.01)	.01 (.36)	.04 (.01)	.08	17.40	1202
	Return on Investment (ROI)	1977	.42 (.01)	.003 (.01)	---	-.28 (.01)	-.02 (.01)	.02 (.26)	-.03 (.24)	.0001 (.99)	.10	17.7	924
		1978	1.77 (.01)	.0001 (.03)	---	-1.75 (.01)	-.03 (.01)	.04 (.06)	-.06 (.01)	-.003 (.89)	.46	164.94	1187
		1979	.95 (.01)	.001 (.01)	---	-.88 (.01)	.01 (.03)	.03 (.01)	-.04 (.01)	-.002 (.88)	.42	145.96	1202
Air Force Sales	Profit Margin Ratio (PMR)	1977	.10 (.01)	---	.00001 (.96)	.27 (.04)	-.02 (.01)	.26 (.05)	.01 (.61)	.003 (.87)	.01	2.24	924
		1978	.08 (.01)	---	-.0002 (.78)	-.30 (.01)	.01 (.01)	.30 (.01)	-.003 (.80)	.02 (.10)	.09	18.76	1184
		1979	.10 (.01)	---	-.0003 (.61)	-.29 (.01)	-.04 (.01)	.27 (.01)	.01 (.38)	.04 (.01)	.08	17.44	1202
	Return on Investment (ROI)	1977	.43 (.01)	---	.001 (.28)	-.28 (.01)	-.02 (.01)	.03 (.22)	-.03 (.18)	.01 (.54)	.08	12.58	924
		1978	1.79 (.01)	---	.0003 (.80)	-1.75 (.01)	-.03 (.01)	.05 (.05)	-.06 (.01)	-.01 (.60)	.45	163.45	1187
		1979	.97 (.01)	---	.001 (.06)	-.88 (.01)	.01 (.06)	.03 (.01)	-.04 (.01)	-.01 (.42)	.41	140.3	1202

* Parenthetical value indicates the probability that the coefficient is equal to zero.

** COGS refers to the cost of goods sold and is used in the profit margin ratio regressions while COS is the cost of goods sold ratio and is used in the return on investment regressions.

sales of profitability. As a final technical point it should be noted
that GSL and DSL represent continuous variables ranging from .00 to .99
(reflecting zero percent government and Air Force sales to 99 percent
government and Air Force sales).

As far as the GSL-PMR relationship is concerned, the results in
Table 4.2 indicate that GSL has positive effect on PMR in 1977 and 1978
but a negative effect in 1979. However, all three effects are statisti-
cally insignificant. (Again the conventional interpretation of statis-
tical significance-the 5 percent level-is employed; that is, a variable
has a statistically significant effect when its parenthetical value in
Table 4.2 is .05 or less.) Reworded, there is no statistical support
for the hypothesis that increases in the percent of a firm's sales going
to the government will raise its profit margin ratio.

Turning to the other data in the GSL-PMR regressions, there is the
expected inverse and statistically significant relationship between PMR
and COGS in each of the three years. As for the other efficiency vari-
able (COR), it too returns a statistically significant and negative
effect in 1977 and 1979. The result for 1978 is unexpected, the COR-PMR
relationship is significant and positive. At this point there is no
explanation for this result; perhaps it is merely a quirk in the data or
an anomaly arising from economic conditions prevailing in 1978. The
first of the two size variables, NSALE, is positive in each of the three
years. It is strongly significant in 1978 and 1979 but only marginally
significant in 1977. The other size variable, ASSET, returns incon-
sistent signs and is statistically insignificant in all three years. As
for the WAD distinction between manufacturers and subcontractors, it is
only important in 1979 when manufacturers have a statistically signifi-

cant higher PMR. In total these results must be interpreted with some caution as the set of explanatory variables explains very little of the variation in PMR, especially in 1977. Simply, the impact of GSL on PMR is being evaluated while important forces acting on PMR are not being controlled for.

Turning to the government sales - return on investment regressions, the results presented in Table 4.2 indicate a positive relationship in each of the three years. Moreover each of these effects is statistically significant. Thus the regression evidence supports the conclusion drawn on the basis of the average behavior comparisons. Indeed, the GSL-POI regressions provide a more substantial basis for this conclusion; the statistically significant higher ROI for firms with greater proportions of government sales appears while controlling for other difference between firms.

It is also interesting to observe the impact of the other explanatory variables on ROI. As expected the first efficiency variable, COS, has a negative and statistically significant impact in each of the three years. This same result obtains for the second efficiency variable, COR, in 1977 and 1978 but COR is positive and significant in 1979. This, as in the case of the positive and significant effect for COR in one of the GSL-PMR regressions, must be considered an anomaly. The two size variables tend to cancel each other out with NSALE being consistently positive and ASSET being consistently negative. In addition the significance levels of the two variables tend to move in the same way between regressions. The results for the WAD variable suggest that classification as a WAD manufacturer or subcontractor makes no difference as far as ROI is concerned; this variable is not significant in any of the

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three GSL-ROI regressions. Overall the set of independent variables explains a much greater amount of the variation in ROI than in PMR; the coefficient of determination for ROI ranges from .10 to .46.

Turning to the regression results for the DSL-PMR relationship, the results in Table 4.2 indicate an inconsistent sign for DSL. It is positive in 1977 and negative in 1978 and 1979. As for the statistical significance of this effect, the probability values support the hypothesis that increasing proportions of Air Force sales do not lead to higher or lower profit margin ratios. This result is consistent with the conclusion drawn from the comparisons of average behavior.

With respect to the other variables in the DSL-PMR regressions, the first efficiency variable (COGS) is, as expected, consistently negative and statistically significant. Consistent with the GSL-PMR regressions, the other efficiency variable (COR) is negative and significant in 1977 and 1979 but positive and significant in 1978. The first of the size variables is consistent, positive and significant in all three years. Thus, it appears that firms with larger sales volumes have higher profit margin ratios. The second size variable is both positive and negative but is statistically insignificant in each of the three years. As in the GSL-PMR regressions, the WAD variable is again significant only in 1979 and here manufacturers have a higher PMR than subcontractors. The coefficients of determination in the DSL-PMR regressions match exactly those obtained in the GSL-PMR regressions. They are fairly low especially in 1977.

As for the final set of regressions in Table 4.2, they indicate that there is a positive relationship in each of the three years between DSL and the other measure of profitability - ROI. But the impact which

DSL has on ROI is statistically insignificant in each of the three years, almost becoming significant in 1979. The conclusion of no statistically significant relationship between DSL and ROI is identical to the conclusion drawn from the comparisons of average behavior.

The DSL-ROI results presented in Table 4.2 also reveal a consistently negative and significant effect for the first efficiency variable - COS. This is to be expected. Also expected are the negative and significant effects for the second size variable, COR, in 1977 and 1978. But once again COR returns a positive and significant effect in one year; thus there is one anomaly for this efficiency variable in each set of regressions. The two size variables return opposite signs in each regression and both are statistically significant in 1977 and 1978. The WAD variable returns mixed signs and is statistically insignificant in each regression. The coefficients of determination in the DSL-ROI regressions are much higher than in the DSL-PMR regressions; the range is now from .08 to .45.

In order to focus the industry analysis even more closely on those industries that might be considered as more concerned with the production and fabrication of aerospace and defense items rather than industries such as agricultural producers from whom the Air Force also buys products, it was decided that an additional series of regressions would be executed. The nature of the focusing was to reduce the number of firms being considered and include only those public aerospace firms which are classified within the SIC 3000-3999 range. The regressions are presented in Table 4.3. The arrangement of the regressions in Table 4.3 is identical to the arrangement of the regressions in Table 4.2 - the same dependent variables (PMR and ROI), the same explanatory vari-

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Table 4.3

Regression Results for Profitability Ratios*

SIC 3000-3999 Firms
(Glossary of Names: Appendix A)

Sales Category	Ratio	Year	Constant	GSL	DSL	COGS/COS**	COR	NSALE	ASSET	WAD	R^2	F-RATIO	N
Government Sales	Profit Margin Ratio (PMR)	1977	.135 (.01)	.0003 (.10)	---	-.244 (.01)	-.089 (.01)	.235 (.01)	.009 (.68)	.017 (.10)	.13	17.02	673
		1978	.100 (.01)	.00003 (.87)	---	-.315 (.01)	-.025 (.03)	.335 (.01)	-.020 (.52)	.028 (.03)	.02	3.34	875
		1979	.079 (.01)	-.00006 (.73)	---	.05 (.56)	.001 (.78)	.204 (-1)	.058 (.07)	.150 (.01)	.03	3.95	888
	Return on Investment (ROI)	1977	1.26 (.01)	.0007 (.01)	---	1.22 (.01)	.02 (.11)	.06 (.01)	-.06 (.01)	-.01 (.32)	.57	148.4	673
		1978	2.47 (.01)	.0001 (.70)	---	-2.49 (.01)	-.05 (.01)	.08 (.07)	-.09 (.05)	-.02 (.30)	.67	295.85	875
		1979	1.57 (.01)	.0002 (.01)	---	-1.45 (.01)	-.12 (.01)	.03 (.01)	-.03 (.01)	-.01 (.03)	.87	981.51	888
Air Force Sales	Profit Margin Ratio (PMR)	1977	.138 (.01)	---	-.0001 (.73)	-.246 (.01)	-.090 (.01)	.238 (.01)	.008 (.73)	.018 (.08)	.13	16.53	673
		1978	.101 (.01)	---	-.0004 (.52)	-.314 (.01)	-.025 (.03)	.334 (.01)	-.020 (.51)	.026 (.04)	.02	3.40	875
		1979	.083 (.01)	---	-.0004 (.45)	-.400 (.01)	.003 (.81)	.441 (.01)	-.044 (.10)	.028 (.01)	.03	4.20	888
	Return on Investment (ROI)	1977	1.27 (.01)	---	.001 (.01)	-1.23 (.10)	.02 (.01)	.06 (.01)	-.06 (.82)	-.002 (.82)	.57	146.81	673
		1978	2.48 (.01)	---	-.0004 (.67)	-2.49 (.01)	-.05 (.01)	.08 (.07)	-.09 (.05)	-.02 (.29)	.67	295.87	875
		1979	1.57 (.01)	---	.001 (.01)	1.45 (.01)	-.13 (.01)	.03 (.01)	-.03 (.01)	-.01 (.04)	.87	992.17	888

* Parenthetical value indicates the probability that the coefficient is equal to zero.
** COGS refers to the cost of goods sold and is used in the profit margin ratio regressions while COS is the cost
of goods sold ratio and is used in the return on investment regressions.

ables (GSL or DSL, COGS or COS, COR, NSALE, ASSET, and WAD), and the
same special interest in the sign and significance of the GSL and DSL
variables. To repeat, the basic difference is in the number of firms:
Table 4.2 includes all firms for whom data were available while Table
4.3 deals only with such firms which were also in the SIC 3000-3999
classification.

As for the GSL-PMR regressions in Table 4.3, the results indicate
that the regrouping of firms has no impact on the statistical signifi-
cance of the GSL variable. It is, as in Table 4.2, statistically in-
significant in all three years. The one difference that does appear in
this set of regressions pertains to the value of the R^2; it increases
for 1977 and decreases for 1978 and 1979.

The GSL-ROI regressions reported in Table 4.3 are most noteworthy
in terms of the increases in R^2 values; in Table 4.2 they ranged from
.10 to .46 while the now range from .57 to .87. As for the GSL vari-
able the general conclusion remains: it is consistently positive and
generally significant. The only unexpected result for this set of re-
gressions is the positive and significant sign for COS and the positive
and insignificant sign for COR in the 1977 regression.

There is no change in the conclusion regarding the impact of DSL
and PMR when the more narrow industrial focus is taken: DSL is con-
sistently insignificant. With the exception of an increased R^2 for
1977, decreased R^2s for 1978 and 1979, and the statistical significance
of WAD in two years as opposed to one year, the DSL-PMR results reported
in Table 4.3 are generally the same as those reported in Table 4.2.

The DSL-ROI results in Table 4.3 are different from those in Table
4.2 in three important respects. First, the new R^2 values are sub-

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stantially higher; they now range from .57 to .87 as opposed to the old

range of .08 to .45. Second, DSL is now positive and significant in two

of the three years suggesting that firms with greater proportions of Air

Force sales have higher rates of return on investment. Third, the WAD

variable is negative and significant in two of the three regressions

implying that WAD defined manufacturers have lower rates of return on

investment than WAD defined subcontractors.

As for an overall assessment of the results presented in Table 4.3

the emphasis is on the impact of industrial structure on the conclusions

regarding the effect of GSL and DSL on PMR and ROI. Here the new re-

gression results are consistent with the old results with one exception:

when the SIC 3000-3999 grouping is employed DSL has a positive and gen-

erally significant impact on ROI.

C. SUMMARY AND CONCLUSIONS

To make this summary as concise as possible, it is useful to take a

very specific question and answer approach. The questions are differ-

entiated on the basis of government and Air Force sales as well as the

measure of profitability.

1. What is the impact of sales to the government on the profit

   margin ratio of corporate segments in the aerospace industry?

   The comparisons of average behavior indicate a positive but

   insignificant effect which is in complete agreement with the

   regression analysis.

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2. What is the impact of sales to the government on return on investment of the corporate segments in the aerospace industry?

The comparisons of average behavior indicate a positive and usually statistically significant effect and this conclusion is even more strongly supported by the regression analysis.

3. What is the impact of sales to the Air Force on the profit margin ratio of corporate segments in the aerospace industry?

The comparisons of average behavior indicate a positive but statistically insignificant relationship while the regression results reflect a negative but also statistically insignificant relationship. Thus, the level of Air Force sales does not appear to impact the profit margin ratio of corporate segments.

4. What is the impact of sales to the Air Force on the return on investment of corporate segments in the aerospace industry?

The comparisons of average behavior reflect a positive and insignificant effect. The regression conclusion, at least as far as statistical significance is concerned, depends on industrial structure: the all firm regressions implying no statistical significance while the SIC 3000-3999 regressions imply, in general, a statistically significant and positive relationship.

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CHAPTER V. EFFICIENCY OF CORPORATE SEGMENTS IN THE AEROSPACE INDUSTRY

This is the second of four analytical chapters. It focuses on the impact of sales to the government and the Air Force on the efficiency of corporate segments in the aerospace industry. The discussion, as in the preceding chapter, begins with the set of average behavior comparisons. This is followed by the regression analysis.

A. AVERAGE BEHAVIOR COMPARISONS

With respect to efficiency there are two versions of the major research question:

(i) What is the impact of sales to the government on the efficiency of corporate segments in the aerospace industry?

(ii) What is the impact of sales to the Air Force on the efficiency of corporate segments in the aerospace industry?

Table 5.1 contains information pertaining to these questions when efficiency is measured by the cost of goods sold ratio (cost of goods sold divided by sales) and the capital-output ratio. Consider first the question of government sales and the cost of goods sold ratio. In 1977 the value of this ratio for the base group (again defined as the group of firms with zero percent sales to the government or the Air Force) is .911. The values of this ratio for the three comparisons groups (again defined as firms with 25 percent or more in government sales, 50 percent or more in government sales, and 75 percent or more in government sales) range from a low of .876 to a high .892. Given these values it is not

Table 5.1

Average Behavior Comparisons: Efficiency Ratios
All Firms

Year	Sales Percentage Comparison**	Firm Group	Government Sales					Air Force Sales				
			n	Cost of Good Sold Ratio Mean	Prob.*	Capital-Output Ratio Mean	Prob.*	n	Cost of Good Sold Ratio Mean	Prob.*	Capital-Output Ratio Mean	Prob.*
1977	0% vs. 75%	0%	851	.911		.945		876	.912		.959	
		75%	47	.876	.39	.512	.16	2	.898	.95	.346	.65
	0% vs. 50%	0%	851	.911		.945		876	.912		.959	
		50%	70	.885	.44	.562	.14	9	.912	.99	.441	.44
	0% vs. 25%	0%	851	.911		.945		876	.912		.959	
		25%	114	.892	.47	.570	.06	23	.907	.94	.463	.24
1978	0% vs. 75%	0%	826	.898		.960		1002	.896		1.020	
		75%	96	.909	.62	.515	.01	5	1.009	.21	.506	.76
	0% vs. 50%	0%	826	.898		.960		1002	.896		1.020	
		50%	142	.906	.67	.573	.01	10	.954	.36	.443	.63
	0% vs. 25%	0%	826	.898		.960		1002	.896		1.020	
		25%	199	.899	.97	.596	.01	23	.926	.48	.477	.49
1979	0% vs. 75%	0%	850	.897		.911		957	.895		.920	
		75%	81	.906	.66	.496	.01	4	.856	.68	.455	.56
	0% vs. 50%	0%	850	.897		.911		957	.895		.920	
		50%	124	.900	.86	.537	.01	8	.978	.21	.602	.57
	0% vs. 25%	0%	850	.897		.911		957	.895		.920	
		25%	191	.895	.87	.609	.04	22	.936	.32	.552	.28

* Prob. values indicate the probabilities that the mean values are equal.

** 0% indicates firms with no slaes to the government or Air Force while the other percentage indicates the percent of sales to the government or Air Force.

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surprising that the ratios are not different from one another in a statistical sense. The same conclusion holds for 1978 and 1979. For 1978 the base group cost of sales ratio is .898 while the ratios for the three comparison groups are .909 (75 percent or more in government sales), .906 (50 percent or more in government sales), and .899 (25 percent or more in government sales). The base group ratio is virtually the same in 1979, .897, while the ratios for the three comparison groups are all somewhat below their 1978 levels, ranging now from .895 to .906.

Changing the measure of efficiency from the cost of goods sold ratio to the capital-output ratio requires a change in the overall conclusion; now the behavior of the base group is different in a statistical sense from the behavior of the comparison groups. This is true for 1978 and 1979 but not for 1977. Taking the results in yearly sequence, the average value of the capital-output ratio for 1977 for the base group is .945 while the average ratio value for the three comparison groups ranges from .512 to .570. Note that as the sample size is increased (as the percent government sales cutoff is lowered from 75 percent to 50 percent to 25 percent) the statistical significance of the differences in averages increases although never quite reaching the conventional standard of statistical significance of 5 percent (a Prob. value of .05 or less). In 1978 the capital-output ratio for the base group increases by a small margin to .960 as do the ratios for the three comparison groups so that the range now is from .515 to .596. For 1978 the three comparison group average ratios are significantly different from the base group ratio even at the .01 probability level. In 1979 the average ratio for the base group declines somewhat to .911 while the range for the three comparison groups widens with a low of .496 and a

high of .609. For 1979 the observed differences in means between the base group and the three comparison groups are statistically significant for the two smaller comparison groups the differences are significant even at the .01 level.

As for an overall assessment of efficiency and government sales, conclusions clearly depend on the measure of efficiency. The level of government sales does not impact significantly on the cost of goods sold ratio but it does impact on the capital-output ratio. The statistics indicate that in 1978 and 1979 firms with government sales were significantly less capital intensive than firms without any government sales.

Shifting the basis of comparison from government sales to Air Force sales requires no change in conclusions regarding the cost of goods sold ratio but it does require a change in the capital-output ratio conclusions. Air Force sales lead to no significant differences in average cost of goods sold ratios and no significant differences in capital-output ratios.

In terms of more detail, the 1977 statistics indicate that the base group had a mean cost of goods sold ratio of .912 while the range for the three corresponding groups has a low of .898 and a high of .912. Clearly these ratios are all very close to each other. For 1978 the base group mean is .896 while the range for the three comparison groups extends from .926 to 1.009. This latter figure again reflects variability that is associated with the small sample size for the group of firms with 75 percent or more in Air Force sales. No group of firms could maintain such a figure for any substantial period and remain in business. The figures for 1979 reveal a relatively constant cost of goods sold ratio of .895 for the base group while the range for the

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three comparison groups is from .856 to .978. To repeat, for each of
the pairwise comparisons for each of the years, the means for the cost of
goods sold ratio are, in a statistical sense, equal.

As for the capital-output ratios, the mean value for the base group
is substantially above the mean value for the three comparison groups.
This is the case in each of the three years suggesting that Air Force
suppliers are less capital intensive than firms without Air Force sales.
However, these differences are not significant in a statistical sense.

As for overall conclusions, government sales and Air Force sales
make no difference in efficiency as measured by the cost of goods sold
ratio. However, government suppliers tend to be less capital intensive
than firms in the aerospace industry that do not sell to the government.

B. REGRESSION ANALYSIS

The regression results for the two efficiency ratios (COS - cost of
goods sold ratio, COR - capital-output ratio) are presented in Table
5.2. There is one important change in the results presented in this
chapter and the regression results presented in both the preceding and
succeeding chapters and it concerns the independent variables. Rather
obviously, when COS is the dependent variable it cannot be used simul-
taneously as an independent variable and correspondingly for COR. Thus
one of the efficiency variables is systematically and appropriately
excluded from each of the regressions.

With respect to the government sales (GSL) and cost of goods sold
ratio regressions, the GSL variable is negative in all three years and
its impact is statistically insignificant in each of the three years.

Table 5.2

Regression Results for Efficiency Ratios*
All Firms
(Glossary of Names: Appendix A)

Sales Category	Ratio	Year	Constant	GSL	DSL	COS	COR	NSALE	ASSET	MAD	R^2	F-RATIO	N
Government Sales	Cost of Goods Sold Ratio (COS)	1977	.90 (.01)	-.0003 (.47)	---	---	.02 (.01)	.02 (.30)	-.03 (.20)	-.001 (.95)	.01	1.89	924
		1978	.93 (.01)	-.00005 (.79)	---	---	-.01 (.01)	.01 (.32)	-.02 (.19)	-.02 (.07)	.08	19.87	1187
		1979	.90 (.01)	-.00003 (.87)	---	---	.04 (.01)	.03 (.01)	-.03 (.01)	-.04 (.01)	.07	18.81	1202
	Capital-Output Ratio (COR)	1977	.38 (.07)	.004 (.09)	---	.53 (.01)	---	-.35 (.01)	.39 (.01)	.04 (.73)	.02	4.10	924
		1978	3.74 (.01)	-.004 (.20)	---	-4.95 (.01)	---	-.27 (.25)	.22 (.35)	-.50 (.02)	.08	20.32	1187
		1979	-.60 (.01)	-.003 (.01)	---	1.64 (.01)	---	-.35 (.01)	.37 (.01)	-.09 (.24)	.08	21.37	1202
Air Force Sales	Cost of Goods Sold Ratio (COS)	1977	.90 (.01)	---	-.00004 (.97)	---	.02 (.01)	.02 (.30)	-.03 (.21)	-.003 (.90)	.01	1.79	924
		1978	.92 (.01)	---	.0002 (.73)	---	-.01 (.01)	.01 (.33)	-.02 (.20)	-.02 (.09)	.08	19.86	1187
		1979	.90 (.01)	---	.0002 (.64)	---	.04 (.01)	.03 (.01)	-.03 (.01)	-.04 (.01)	.07	18.85	1202
	Capital-Output Ratio (COR)	1977	.38 (.06)	---	.01 (.23)	.54 (.01)	---	-.35 (.01)	.39 (.01)	.0003 (.99)	.02	3.80	924
		1978	5.68 (.01)	---	-.009 (.43)	-4.94 (.01)	---	-.27 (.24)	.23 (.32)	-.48 (.03)	.8	20.11	1187
		1979	-.66 (.01)	---	-.01 (.15)	1.66 (.01)	---	-.36 (.01)	.38 (.01)	-.07 (.36)	.08	20.31	1202

*Parenthetical value indicates the probability that the coefficient is equal to zero.

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This result is fully consistent with the results from the comparisons of average behavior which also indicated that firms with government sales did not have statistically significant higher or lower cost of goods sold ratios than firms without government sales.

As for the other statistics associated with these regressions, there is a positive relationship which is statistically significant in two of the three years between COR and COS. This pattern is disrupted by a negative and significant relationship in 1978. The two size variables return opposite signs in each regression but both are statistically significant only in the 1979 regression. The WAD variable suggests that firms classified by WAD as subcontractors tend to have lower cost of goods sold ratios. This effect is significant only in 1979. Finally, the ability of the set of explanatory variables to explain the variability in COS is quite low; the coefficient of determination has values of .08 in 1978, .07 in 1979, and only .01 in 1977. Clearly this regression specification is ignoring important factors which account for variations in COS between firms and the regression results must be interpreted accordingly.

Turning to COR and its relationship to GSL, the results presented in Table 5.2 indicate a negative relationship in each of the three years. This consistency of sign is not matched by a consistency of statistical significance; GSL is insignificant in 1977 and 1978 yet significant at the 1 percent level in 1979. This inconsistency of statistical significance in the regression results is in contrast to the fairly consistent conclusion in the comparisons of average behavior that firms with government sales tend to have a significantly lower capital-output ratio. Perhaps the best interpretation to place on the regression results is that they

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marginally support the hypothesis that an increase in GSL means lower capital intensity.

Switching the analysis from GSL to DSL and beginning with the cost of goods sold ratio, the results presented in Table 5.2 indicate an insignificant relationship. This lack of statistical significance in the relationship between DSL and COS also obtained in the average behavior comparisons.

As for the remaining regression output, there is a positive relationship between COR and COS in two of the three years and each is significant. There is also the negative and statistically significant effect for 1978. The two size variables again return opposite signs in each regression but the coefficients are statistically significant only in 1979. The WAD variable reveals a consistently lower COS for WAD identified manufacturers; however, this effect is statistically significant only in 1979. Again all of these results must be interpreted in the context of the extremely low overall explanatory power of the regression equation; the R^2s range from .01 to .08.

The regression results for DSL and COR indicate that Air Force suppliers have lower capital-output ratios. This result was also revealed in the average behavior comparisons. But none of the regression identified negative DSL coefficients is statistically significant. This lack of statistical significance is also consistent with the average behavior analysis.

With respect to the other regression statistics, the relationship between COS and COR is positive (as might be expected) and statistically significant in two of the three years with a negative and statistically significant effect in 1978. The two size variables again return oppo-

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site signs in each regression, NSALE is consistently negative while ASSET is consistently positive, and each is statistically significant in the 1977 and 1979 regressions. The WAD variable returns mixed signs with only the negative effect for 1978 being significant. Finally, as in all the regressions for the efficiency measures, the R^2 values are extremely low, which leads to caution regarding the degree of confidence that may be placed in the regression results.

To supplement the analysis presented in Table 5.2 it was again decided that it might be useful to evaluate the impact of government and Air Force sales when only firms in the SIC 3000-3999 range are included. This has the impact of reducing the number of observations but at the same time sharpening the focus on actual producing units. These results are presented in Table 5.3.

Comparing the GSL-COS regression in Tables 5.2 and 5.3, the same general patterns tend to hold: (i) GSL tends to be negative and is consistently insignificant; (ii) COR is positive and significant in two of the three years; (iii) the two size variables are oppositely signed in each regression and also insignificant in each regression; (iv) the WAD variable is negative in all regressions but now is significant in two years rather than one; and (v) the R^2s remain low.

The new GSL-COR regressions also are quite similar to the prior regressions: GSL is consistently negative and marginally significant; COS is now positive in all three years but significant in only two; the two size variables are of opposite signs and statistically significant in all regressions; WAD is now consistently positive and insignificant; and the R^2s remain low.

As for the DSL-COS regressions the differences with respect to sign

Table 5.3

Regression Results For Efficiency Ratios*

SIC 3000-3999 Firms
(Glossary of Names: Appendix A)

Sales Category	Ratio	Year	Constant	GSL	DSL	COS	COR	NSALE	ASSET	WAD	R^2	F-RATIO	N
Government Sales	Cost of Goods Sold Ratio (COS)	1977	.86 (.01)	-.0003 (.09)	---	---	.09 (.01)	.03 (.08)	.04 (.06)	-.02 (.09)	-.12	17.60	673
		1978	.90 (.01)	.000001 (.96)	---	---	.03 (.02)	.03 (.21)	-.03 (.18)	-.03 (.02)	.01	2.23	875
		1979	.91 (.01)	-.000001 (.59)	---	---	.0002 (.98)	.03 (.14)	-.03 (.12)	-.03 (.01)	.01	2.27	888
	Capital-Output Ratio (COR)	1977	-.43 (.01)	-.0007 (.28)	---	1.17 (.01)	---	-.30 (.01)	.33 (.01)	.05 (.22)	.13	20.68	673
		1978	.45 (.01)	-.001 (.06)	---	.23 (.02)	---	-.28 (.01)	.28 (.01)	.05 (.17)	.03	5.50	875
		1979	.65 (.01)	-.001 (.01)	---	.001 (.98)	---	-.20 (.01)	.20 (.01)	.03 (.34)	.03	6.53	888
Air Force Sales	Cost of Goods Sold Ratio (COS)	1977	.86 (.01)	---	.0001 (.75)	---	.09 (.01)	.03 (.09)	-.04 (.07)	-.02 (.08)	.11	16.98	673
		1978	.90 (.01)	---	.0004 (.51)	---	.03 (.02)	.03 (.23)	-.03 (.20)	-.03 (.03)	.01	2.32	875
		1979	.91 (.01)	---	.0003 (.58)	---	.001 (.92)	.03 (.15)	-.03 (.13)	-.03 (.01)	.01	2.28	888
	Capital-Output Ratio (COR)	1977	-.43 (.01)	---	-.003 (.04)	1.18 (.01)	---	-.30 (.01)	.32 (.01)	.03 (.45)	.14	21.35	673
		1978	.43 (.01)	---	-.003 (.10)	.23 (.02)	---	-.28 (.01)	.28 (.01)	.06 (.14)	.03	5.31	875
		1979	.62 (.01)	---	-.002 (.25)	.009 (.92)	---	-.205 (.01)	.21 (.01)	.04 (.15)	.03	4.89	888

*Parenthetical value indicates the probability that the coefficient is equal to zero.

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and significance are as follows: (i) DSL is now positive but remains insignificant; (ii) COR is now positive and significant in 1978; (iii) ASSET is negative and significant in 1979; (iv) WAD is negative and significant in 1978; and (v) there is minor variation in the R^2 values.

The DSL-COR regressions also reflect only very minor changes. The significant changes are for COS in the 1978 regression (it is now positive and significant); COS in the 1979 regression (it is now positive and insignificant); NSALE is negative and significant in the 1978 regression while ASSET is positive and significant; and WAD is now positive and insignificant in all three years.

It would appear then that changing the sample of firms to only those included in the SIC 3000-3999 classifications generates a few minor but no major changes in the conclusions.

C. SUMMARY AND CONCLUSIONS

In terms of summarizing the analysis presented in this chapter a very piecemeal approach is again in order. Each version of the major research question is restated in terms of each efficiency measure.

1. What is the impact of sales to the government on the cost of goods sold ratio of corporate segments in the aerospace indus-try?

    Both the average behavior comparisons and the regression anal-ysis suggest that an increase in GSL implies a reduction in COS but the relationship is not statistically significant.

2. What is the impact of sales to the government on the capital-
   output ratio of corporate segments in the aerospace industry?

   Both the average behavior comparisons and the regression anal-
   ysis support the hypothesis that government suppliers have
   lower capital-output ratios; that is, they tend to be less
   capital intensive. As for statistical significance, the sup-
   port is stronger from the average behavior comparisons with
   the regression results suggesting consistent statistical sig-
   nificance but only marginally.

3. What is the impact of sales to the Air Force on the cost of
   goods sold ratio of corporate segments in the aerospace in-
   dustry?

   Both the average behavior comparisons and the regression anal-
   ysis indicate that there is no consistently significant rela-
   tionship between Air Force sales and the cost of goods sold
   ratio.

4. What is the impact of sales to the Air Force on the capital-
   output ratio of corporate segments in the aerospace industry?

   Both the average behavior comparisons and the regression anal-
   ysis reflect lower capital-output ratios (less capital inten-
   sity) for Air Force firms but that this difference tends to be
   statistically insignificant.

CHAPTER VI. CAPITAL MANAGEMENT OF CORPORATE SEGMENTS IN THE AEROSPACE INDUSTRY

This is the third of four analytical chapters. It focuses on the impact of sales to the government and the Air Force on the capital management of corporate segments in the aerospace industry. As was the case in each of the previous two chapters, the discussion begins with the set of average behavior comparisons. The regression analysis follows these comparisons.

A.   AVERAGE BEHAVIOR COMPARISONS

With respect to capital management, as was the case with profitability and efficiency, there are two versions of the major research question:

(i) What is the impact of sales to the government on the capital management of corporate segments in the aerospace industry?

(ii) What is the impact of sales to the Air Force on the capital management of corporate segments in the aerospace industry?

Table 6.1 contains information pertaining to these two questions when capital management is measured by the gross replacement ratio (capital expenditures divided by identifiable assets), the net replacement ratio (the difference between capital expenditures and depreciation divided by identifiable assets), and the capital change ratio (capital expenditures divided by depreciation). Consider first the question of government sales and the gross replacement ratio. For 1977 the ratio for the base group (as in the previous chapters the base group is the group of firms with zero percent sales to the government) the gross

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Table 6.1
Average Behavior Comparison: Capital Management Ratios
All Firms

Year	Sales Percentage Comparison **	Firm Group	n	Government Sales						n	Air Force Sales					
				Gross Replacement Ratio		Net Replacement Ratio		Capital Change Ratio			Gross Replacement Ratio		Net Replacement Ratio		Capital Change Ratio	
				Mean	Prob.*	Mean	Prob.*	Mean	Prob.*		Mean	Prob.*	Mean	Prob.*	Mean	Prob.*
1977	0% vs. 75%	0%	699	.073		.030		2.048		709	.073		.030		2.102	
		75%	38	.069	.70	.026	.71	1.899	.72	2	.173	.0?	.092	.19	2.820	.70
	0% vs. 50%	0%	699	.073		.030		2.048		709	.073		.030		2.102	
		50%	48	.069	.61	.026	.75	2.475	.54	9	.103	.29	.048	.46	1.968	.89
	0% vs. 25%	0%	699	.073		.030		2.048		709	.073		.039		2.102	
		25%	85	.075	.84	.032	.78	2.143	.74	20	.097	.12	.046	.28	2.005	.87
1978	0% vs. 75%	0%	791	.075		.035		2.260		961	.075		.036		12.625	
		75%	95	.074	.97	.035	.90	107.453	.01	5	.070	.86	.033	.98	1.918	.94
	0% vs. 50%	0%	791	.075		.035		2.260		961	.075		.036		12.625	
		50%	138	.072	.69	.035	.91	74.643	.02	10	.075	.99	.031	.83	1.731	.92
	0% vs. 25%	0%	791	.075		.035		2.262		961	.075		.036		12.625	
		25%	194	.075	.94	.037	.81	53.711	.04	23	.105	.05	.062	.05	2.700	.88
1979	0% vs. 75%	0%	825	.076		.036		14.326		933	.076		.037		12.9333	
		75%	79	.086	.18	.049	.07	2.882	.77	3	.039	.33	.015		2.115	.95
	0% vs. 50%	0%	825	.076		.036		14.326		933	.076		.037		12.933	
		50%	121	.086	.10	.049	.03	2.763	.72	7	.076	.98	.044	.77	2.540	.93
	0% vs. 25%	0%	825	.076		.036		14.326		933	.076		.037		12.933	
		25%	188	.082	.19	.044	.09	2.504	.64	21	.075	.93	.039	.88	2.163	.88

*Prob. values indicate the probabilities that the mean values are equal.

** 0% indicates firms with no sales to the government or Air Force while the other percentage indicates the percent of sales to the government or Air Force.

replacement ratio is .073; capital expenditures unadjusted for depreciation charges average about 7 percent of identifiable assets. The corresponding ratios for the three comparison groups (also as in the previous chapters firms with 75 percent or more in sales to the government, firms with 50 percent or more in sales to the government, and firms with 25 percent or more in sales to the government) are all of a similar order of magnitude with a range from .069 to .075. As the closeness of these mean ratios suggests, they are statistically equal; that is, there is no statistically significant difference in these values. The figures for 1978 are almost the same: the mean ratio for the base group is .075 while the range for the three comparison groups extends from .072 to .075 with the values being statistically the same. For 1979 the gap between the base group and the three comparison groups increases somewhat; the base group average ratio is .076 and the range for the three comparison groups has a low of .082 and a high of .086. But the 1979 conclusion is the same as those drawn for 1977 and 1978: there is no statistical significance to the differences between the ratios for the base group and those of the three comparison groups.

In an overall sense this same conclusion holds when the analysis shifts to government sales and the net replacement ratio. For 1977 the value of this ratio for the base group is .030, meaning that after adjustment for depreciation capital expenditures amounted to 3 percent of identifiable assets. The values of the net replacement ratio for the three comparison groups ranges from .026 to .032 with no statistical significance associated with the differences in these ratios and that of the base group. In 1978 the average ratio values are even more closely clustered and the hypothesis that these values are unequal is rejected

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with even greater confidence. 1979 presents a somewhat different pat-
tern in that there is greater dispersion of the ratios; the value for
the base group is .036 while the values for the three comparison groups
extend from .044 to .049. As the probability values in Table 6.1 indi-
cate, the probability that the ratios for the base group and the com-
parison group with 75 percent or more in government sales are equal is
only .07; that is, the difference in the ratios is almost statistically
significant at the conventional 5 percent level. As for the comparison
between the base group and the group with 50 percent or more in govern-
ment sales, the ratios are unequal in a statistically significant sense.
The result for the last pairwise comparison suggests that there is no
statistically significant difference in the ratios between the base
group and the group of firms with 25 percent or more in sales to the
government.

With respect to government sales and the capital change ratio there
is inconsistency between years. For 1977 and 1979 the behavior of the
base group and each of the three comparison groups can be considered as
statistically the same. However, for the remaining year of 1978, the
capital change ratio for the base group is substantially less than the
corresponding ratios for the three comparison groups and these differ-
ences are statistically significant. A word of caution regarding the
results for the capital change ratio is in order. The figures are sub-
ject to substantial variation on a year to year basis. For example
between 1977 and 1978 the value of this ratio for the comparison group
with 75 percent or more in government sales increases from 1.899 to
107.453 and then falls to 2.882 in 1979 while between 1978 and 1979 the
ratio for the base group increases from 2.260 to 14.326.

To summarize across measures of capital management, the results are
fairly consistent. With the exception of one of three comparisons in-
volving the net replacement ratio in 1979 and all three comparisons for
the capital change ratio in 1978, the results support the conclusion of
no statistically significant difference in the capital management be-
havior of firms without government sales and those with government sales.

Turning to the relationship between sales to the Air Force and
capital management behavior, the same general conclusion can be drawn.
Beginning with the gross replacement ratio measure of capital manage-
ment, there are only two instances where the differences in the average
values of the ratios are statistically significant. The first case
occurs in 1977 with the comparison between the base group and firms with
75 percent or more in Air Force sales (note that there are only two
firms in this group in 1977). The second case arises in 1978 with the
comparison of the base group and the group of firms with 25 percent or
more in Air Force sales.

With the net replacement ratio the number of instances in which the
average ratios are significantly different from one another falls to
just one. This is the case for the comparison between the base group
and the group of firms with 25 percent of more in Air Force sales in
1978.

As for the capital change ratio, there are no instances where the
average capital change ratio for the base group is significantly differ-
ent from the average ratio for the three comparison groups.

It is clear then that in the overall sense neither Air Force sales
nor government sa'es alter capital management behavior in any statis-
tically significant manner. This conclusion is, of course, limited to

the three measures of capital management used here.

B.   REGRESSION ANALYSIS

The regression results for each of the three measures of capital management (GRR is the gross replacement ratio, NRR is the net replacement ratio, and CAPCNG is the capital change ratio) for each of the three years for both government sales (GSL) and Air Force sales (DSL) are presented in Table 6.2. The procedure will be to examine the impact of GSL on the three measures of capital management and then turn to an examination of the relationships between DSL and the three measures of capital management.

The data presented in Table 6.2 indicate a consistently positive relationship between GSL and GRR. But the relationship is not statistically significant in any of the three years. As for the other regression statistics, the COS effect is both positive and negative but is statistically insignificant in all three years. COR is consistently positive and statistically significant in two of the three regressions. The two size variables are consistently insignificant with ASSET being positive in all three years while NSALE is positive in two. The WAD variable results suggest that classification as a WAD manufacturer or a WAD subcontractor has no significant impact on GRR. As was the case for the efficiency variables discussed in the preceding chapter, the overall explanatory power of the set of independent variables is quite low.

The relationship between GSL and NRR is the same as the relationship between GSL and GRR in that a consistently positive sign is obtained. But now the effect is statistically significant in one of the

Table 6.2

Regression Results for Capital Management Ratios*

All Firms

(Glossary of Variables: Appendix A)

Sales Category	Ratio	Year	Constant	GSL	DSL	COS	COR	NSALE	ASSET	WAD	R²	F-RATIO	N
Government Sales	Gross Replacement Ratio (GRR)	1977	.09 (.01)	.00003 (.77)	---	-.01 (.12)	.006 (.01)	-.001 (.84)	.01 (.28)	.01 (.19)	.02	2.69	882
		1978	.05 (.01)	.00004 (.58)	---	.02 (.17)	.01 (.01)	.003 (.58)	.002 (.65)	.004 (.36)	.02	3.09	1156
		1979	.06 (.01)	.0001 (.07)	---	.02 (.10)	.002 (.32)	.001 (.85)	.01 (.15)	.002 (.70)	.02	3.65	1178
	Net Replacement Ratio (NRR)	1977	.04 (.01)	.00002 (.84)	---	-.02 (.03)	.01 (.01)	-.0004 (.93)	.002 (.68)	-.002 (.71)	.02	3.00	882
		1978	.01 (.51)	.0001 (.32)	---	.01 (.23)	.01 (.02)	.002 (.63)	-.0004 (.93)	.01 (.05)	.02	4.39	1156
		1979	.01 (.16)	.0002 (.01)	---	.02 (.18)	.003 (.07)	-.001 (.83)	.005 (.22)	.01 (.16)	.02	3.10	1178
	Capital Change (CAPCNG)	1977	2.27 (.01)	.001 (.79)	---	-.49 (.16)	.29 (.01)	.03 (.87)	-.09 (.66)	-.03 (.89)	.01	1.87	882
		1978	-26.67 (.62)	1.00 (.01)	---	21.46 (.70)	29.03 (.02)	-13.16 (.53)	14.01 (.52)	-21.90 (.29)	.02	3.13	1156
		1979	19.34 (.71)	-.23 (.50)	---	18.79 (.73)	3.47 (.66)	-16.09 (.42)	-16.24 (.42)	-.33 (.09)	.003	.77	1178
Air Force Sales	Gross Replacement Ratio (GRR)	1977	.08 (.01)	---	.00004 (.09)	-.01 (.11)	.006 (.01)	-.001 (.81)	.01 (.26)	-.01 (.32)	.02	3.16	886
		1978	.05 (.01)	---	.0004 (.08)	.02 (.18)	.01 (.01)	.003 (.60)	.002 (.63)	.005 (.26)	.02	3.55	1156
		1979	.06 (.01)	---	.00001 (.97)	.02 (.10)	.001 (.39)	.001 (.81)	.01 (.18)	.0001 (.98)	.02	3.10	1178
	Net Replacement Ratio (NRR)	1977	.04 (.01)	---	.0003 (.23)	-.02 (.03)	.01 (.01)	-.001 (.91)	.002 (.66)	.001 (.88)	.02	3.23	882
		1978	.01 (.50)	---	.0004 (.07)	.01 (.24)	.01 (.01)	.002 (.64)	-.0003 (.94)	.01 (.03)	.02	4.79	1156
		1979	.02 (.08)	---	.0001 (.59)	.02 (.12)	.003 (.10)	-.001 (.87)	.005 (.26)	.004 (.32)	.01	2.12	1178
	Capital Change (CAPCNG)	1977	2.29 (.01)	---	-.01 (.89)	-.48 (.16)	.28 (.01)	.03 (.86)	-.09 (.65)	-.03 (.89)	.01	1.87	882
		1978	-.03 (.99)	---	-.36 (.73)	22.56 (.69)	24.84 (.04)	-11.22 (.60)	10.10 (.64)	-35.81 (.08)	.01	1.48	1156
		1979	16.03 (.76)	---	-.53 (.64)	19.34 (.72)	3.71 (.63)	-16.17 (.41)	16.62 (.41)	-32.81 (.10)	.003	.73	1178

*Parenthetical value indicates the probability that the coefficient is equal to zero.

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three years. The positive relationship between GSL and NRR revealed by the regression analysis is generally consistent with the results from the average behavior comparisons, although in the latter instance stat-istical significance was usually lacking. The remaining regression results indicate that COS operates inconsistently on NRR: a negative and significant effect in 1977, a positive and insignificant effect in 1978 and 1979. Second, the COR impact is consistently positive and significant in two of the three years. Third, the two size variables return opposite signs in each regression but both effects are consis-tently insignificant. Fourth, the WAD manufacturer-subcontractor dis-tinction is statistically significant only in 1978 with WAD manufactur-ers having a higher NRR in that year. Fifth and finally, the coeffi-cients of determination remain very low.

The regressions for the capital change variable are marked by an extensive degree of instability. Perhaps this is not surprising given the variability of this ratio as indicated by the data in Table 6.1. As for the relationship between GSL and CAPCNG, the coefficient for GSL is positive and insignificant in 1977, positive and significant in 1978, and negative and insignificant in 1979. Clearly there is no consistent and significant effect, a conclusion generally in agreement with the average behavior comparisons. The statistics for the two size, two efficiency, and the WAD variables also exhibit instability between years. COS is negative and insignificant in 1977 and positive and insignificant in 1978 and 1979. In addition there is a marked change in the size of the coefficient between 1977 and 1978. COR does behave with some consistency, being positive and significant in two of the three years, but there is inconsistency in terms of the size of the regression coefficient. NSALE

is consistent in its lack of statistical significance and the size of
the coefficient yet inconsistent with respect to sign. Exactly the same
pattern holds for ASSET. WAD is consistent in its lack of statistical
significance. As with the other measures of capital management, the
overall ability of the set of independent variables to explain the variation
in the capital change ratio is quite low; the coefficient of determination
varies from .003 to .01.

In an overall sense the regressions in which sales to the Air Force
replace sales to the government as an explanatory variable are fairly
similar. As was the case in the GSL-GRR regressions, the key variable
in the DSL-GRR regressions (DSL) is positive in all three regressions
but is not statistically significant. This means, of course, that in-
creases in Air Force sales have no impact on the ratio of capital expen-
ditures to identifiable assets. The average behavior comparisons had
suggested the same positive effect and also indicated a lack of stat-
istical significance. The behavior of the other explanatory variables
in the DSL-GRR regressions is also interesting. COS is erratic in sign
but always insignificant. COR is positive in all three years and stat-
istically significant in 1977 and 1978. Note that the results for COS
and COR in the DSL-GRR regressions are almost the same as in the GSL-GRR
regressions. The two size variables are insignificant in each regres-
sion. The sign of the WAD variable changes but the effect is statis-
tically insignificant in all three years. Another similarity between
the GSL-GRR and the DSL-GRR regressions is the consistently low coef-
ficients of determination.

There are also similarities between the GSL-NRR and DSL-NRR regres-
sions. As before the key variable, DSL, is positive in all three re-

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gressions but statistically insignificant in all years. Turning to the
other explanatory variables in the DSL-NRR regressions, COS is incon-
sistent. It is negative and significant in the 1977 regression and then
positive and insignificant in 1978 and 1979. COR is positive in all
three regressions and statistically significant in two of the three
years. The results for the two size variables in these regressions are
the same as in the GSL-NRR regressions; both variables are statistically
insignificant in all three years. The WAD classification as a manu-
facturer or a subcontractor makes a difference in a statistical sense
only in 1978. A final similarity between the GSL-NRR and the DSL-NRR
regressions is the basic inability of the set of explanatory variables
to explain the variation in the dependent variable.

As for the capital change measure of capital management, the DSL
variable operates negatively in all three years. It is also statis-
tically insignificant in all three years. This latter result is in full
accord with the implications of the comparisons of average behavior. As
for the other independent variables in the regressions, the only one
which operates with any consistency is COR. It (COR) is positive in all
three regressions and statistically significant in 1978 and 1979. But
there is considerable variability in the size of the coefficient, it
ranges from .28 to 28.84 (a variability which is also exhibited in the
GSL-CAPCNG regressions). COS is not only variable with respect to size
and sign but is statistically insignificant. NSALE, ASSET and WAD are
all statistically insignificant in each regression and all are variable
with respect to size. Once again the set of independent variables ex-
plains very little of the variation in the dependent variable.

As in the previous chapters it was decided that a supplemental

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regression analysis which restricted the firm sample to just those in the SIC 3000-3999 classification might be useful. These results are presented in Table 6.3. This change in the sample of firms does make a difference in certain conclusions. First, the set of explanatory variables tends to explain somewhat more of the variation in the capital management ratios for the SIC 3000-3999 sample. Second, in the GSL-GRR regressions the GSL and COS effects are now significant in two rather than just one year and ASSET is significant in all three years. Third, in the GSL-NRR regressions, GSL and COS are also significant in two years rather than in just one. Fourth, in the DSL-GRR regressions, DSL is now positive and significant in two of the regressions while ASSET is positive in all three regressions. Fifth, in the DSL-NRR regressions DSL is positive and significant in two of the three regressions. Thus, it would appear that moving to the SIC 3000-3999 classification of firms has the effect of making the GSL and DSL impacts more frequently significant. That is, with this sample, firms with higher percentages of government or Air Force sales tend to have higher gross and net replacement ratios. This dependency of conclusions upon the particular sample employed, like the low R^2 values, raises the need for caution in interpreting these results.

C. SUMMARY AND CONCLUSIONS

Because a precise summary is useful, each version of the major research question for each of the three measures of capital management is restated. Concise statements of conclusions from both the average behavior comparisons and the regressions analysis are then made.

Regression Results for Capital Management Ratios*
SIC 3000-3999 Firms
(Glossary of Variables: Appendix A)

Sales Category	Ratio	Year	Constant	GSL	DSL	COS	COR	NSALE	ASSET	WAD	R^2	F-RATIO	N
Government Sales	Gross Replacement Ratio (GRR)	1977	.10 (.01)	.0009 (.25)	---	-.05 (.01)	.01 (.01)	-.01 (.08)	.02 (.02)	-.01 (.14)	.04	5.06	648
		1978	.03 (.01)	.001 (.05)	---	.035 (.01)	.002 (.69)	-.01 (.14)	.02 (.03)	-.003 (.51)	.03	3.85	860
		1979	.06 (.01)	.0002 (.01)	---	.00006 (.99)	.02 (.01)	-.01 (.25)	.02 (.03)	.0001 (.98)	.04	6.70	875
	Net Replacement Ratio (NRR)	1977	.10 (.01)	.00003 (.67)	---	-.09 (.01)	.02 (.01)	-.003 (.74)	.005 (.54)	-.003 (.48)	.05	5.87	648
		1978	-.01 (.40)	.0001 (.04)	---	.03 (.01)	.01 (.01)	-.006 (.45)	.01 (.29)	.005 (.19)	.02	3.07	860
		1979	.01 (.44)	.0002 (.01)	---	-.002 (.87)	.03 (.01)	-.005 (.45)	.01 (.16)	-.004 (.29)	.05	6.88	875
	Capital Change (CAPCNS)	1977	3.43 (.01)	.002 (.49)	---	-2.14 (.01)	.55 (.01)	.29 (.35)	-.36 (.29)	-.02 (.90)	.02	1.89	648
		1978	-134.18 (.10)	.49 (.01)	---	-2.81 (.97)	234.88 (.01)	-39.28 (.45)	40.47 (.44)	-31.75 (.24)	.06	8.63	860
		1979	-96.81 (.27)	-.14 (.74)	---	50.42 (.57)	157.31 (.01)	38.80 (.39)	38.25 (.40)	-46.12 (.08)	.02	3.32	875
Air Force Sales	Gross Replacement Ratio (GRR)	1977	.10 (.01)	---	.0007 (.01)	-.06 (.01)	.02 (.01)	-.01 (.06)	.02 (.01)	-.003 (.45)	.06	6.93	648
		1978	.03 (.01)	---	.0001 (.05)	.04 (.01)	.002 (.69)	-.02 (.14)	.02 (.03)	.003 (.51)	.03	3.85	860
		1979	.06 (.01)	---	.0002 (.24)	-.001 (.95)	.02 (.01)	-.01 (.27)	.02 (.04)	-.002 (.65)	.04	5.27	875
	Net Replacement Ratio (NRR)	1977	.10 (.01)	---	.0005 (.01)	-.096 (.01)	.02 (.01)	-.003 (.67)	.006 (.48)	-.0008 (.85)	.06	7.09	648
		1978	-.009 (.48)	---	.0005 (.01)	.03 (.01)	.01 (.06)	-.006 (.43)	.009 (.27)	.006 (.17)	.02	3.58	860
		1979	.02 (.21)	---	.0004 (.12)	-.003 (.81)	.03 (.01)	-.005 (.47)	.009 (.19)	.002 (.55)	.04	5.26	875
	Capital Change (CAPCNS)	1977	3.46 (.01)	---	.004 (.62)	-2.18 (.01)	.56 (.01)	.29 (.35)	-.36 (.29)	.007 (.97)	.02	1.95	648
		1978	-91.23 (.27)	---	.09 (.94)	-3.19 (.97)	222.14 (.01)	-29.82 (.57)	28.30 (.59)	-49.96 (.06)	.04	6.68	860
		1979	-99.78 (.25)	---	-.55 (.71)	51.55 (.56)	158.61 (.01)	-38.39 (.40)	38.03 (.41)	46.01 (.08)	.02	3.32	875

*Parenthetical value indicates the probability that the coefficient is equal to zero.

1. What is the impact of sales to the government on the gross replacement ratio of corporate segments in the aerospace industry?

   The comparisons of average behavior indicate that there is no statistically significant impact, as does the regressions analysis when the regression analysis includes all firms. However, the impact is generally positive and significant for SIC 3000-3999 firms.

2. What is the impact of sales to the government on the net replacement ratio of corporate segments in the aerospace industry?

   According to the comparisons of average behavior there is no statistically significant impact while the regression analysis reveals a consistently positive impact which is significant in only one year. For the SIC 3000-3999 firms the impact is significant and positive in two years.

3. What is the impact of sales to the government on the capital change ratio of corporate segments in the aerospace industry?

   The comparisons of average behavior and the regression analysis indicate a significant effect in only one year and it is positive.

4. What is the impact of sales to the Air Force on the gross replacement ratio of corporate segments in the aerospace industry?

    The comparisons of average behavior suggest a positive but generally insignificant effect while the regression analysis for the inclusive sample of firms indicates a positive but generally insignificant effect. It is generally significant for SIC 3000-3999 firms.

5. What is the impact of sales to the Air Force on the net replacement ratio of corporate segments in the aerospace industry?

    Both the comparisons of average behavior and the regressions analysis suggest a positive impact but it is generally insignificant for the inclusive sample of firms. It is generally significant for the SIC 3000-3999 firms.

6. What is the impact of sales to the Air Force on the capital change ratio of corporate segments in the aerospace industry?

    Both comparisons of average behavior and the regressions analysis indicate that the impact is consistently insignificant.

CHAPTER VII. REGRESSION ANALYSIS FOR SELECTED ASPECTS OF FIRM BEHAVIOR

This is the fourth and final analytical chapter. It presents regression results with respect to three additional measures of firm behavior. The first is the labor-output ratio which like the cost of goods sold ratio and the capital-output ratio can be considered as an efficiency measure. The second is the order backlog ratio (order backlog divided by net sales). In the context of the Phase I classification of areas of firm behavior, this ratio is considered a product specialization measure. The third ratio is the research to sales ratio. It too can be considered a measure of product specialization.

Before examining the regression results it is important to explain why the comparisons of average behavior are omitted in the current discussion. They have been omitted because the present analysis deals with a substantially smaller number of firms; the COMPUSTAT Business Information File provided information relevant to the three ratios only on an infrequent basis. Thus, the base group would necessarily be smaller than the base group referenced in the preceding chapters. Even more important is the fact that the comparison groups would be extremely small. For example, for the labor-output ratio there are no firms with even 50 percent or more in government or Air Force sales. Comparisons in such cases are obviously impossible. In other cases the comparison groups would consist of such a small number of firms that the analysis could not really be considered descriptive.

In each of the regressions which follow each of the three specialized

ratios is used as a dependent variable. The set of independent or explanatory variables used in the regressions is the same as that used in the regressions discussed in Chapters IV, V, and VI. The main task of the regressions is to determine first the impact of sales to the government on these ratios and then the impact of sales to the Air Force on these ratios.

It is important to note that the data problems which preclude a comparison of average behavior also lead to the fact that the number of corporate segments included in the regression analysis is substantially less than the number employed in the regressions in Chapter IV, V, and VI. For example, the maximum number of corporate segments in the regressions presented in this chapter is 434 while the minimum number of corporate segments in the regressions discussed in Chapters IV, V, and VI is 862. This degree of variability in sample size demands a clear distinction. Consequently, in this chapter this distinction will be repeated from time to time.

A. GOVERNMENT SALES REGRESSIONS

The regressions results presented in Table 7.1 indicate a positive relationship between the percent of government sales (GSL) and the labor-output ratio (LOR); that is, government suppliers are more labor intensive than firms which are not government suppliers. Moreover, this relationship is statistically significant at the one percent level in 1977 and 1978. For 1979 GSL just misses the conventional standard for statistical significance used throughout this report; it is statistically significant at the 6 percent level but not at the 5 percent level.

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Table 7.1

Regression Results for Labor-Output Ratio, Order-Backlog Ratio, and Research to Sales Ratio*
Government Sales
All Firms

(Glossary of Variables: Appendix A)

Ratio	Year	Constant	GSL	DSL	COS	COR	NSALE	ASSET	WAO	R^2	F-RATIO	N
Labor-Output Ratio (LOR)	1977	.02 (.24)	.0001 (.01)	---	-.01 (.44)	.02 (.01)	.01 (.04)	-.01 (.03)	.001 (.52)	.28	6.57	109
	1978	.005 (.20)	.0001 (.01)	---	-.003 (.45)	.02 (.01)	.01 (.01)	-.01 (.01)	.003 (.07)	.32	11.92	159
	1979	.02 (.01)	.00004 (.06)	---	-.003 (.26)	.009 (.01)	.002 (.45)	-.002 (.39)	.002 (.13)	.20	6.66	165
Order-Backlog Ratio (OBR)	1977	.43 (.10)	.01 (.01)	---	.31 (.29)	-.01 (.87)	.11 (.74)	-.11 (.66)	-.31 (.01)	.20	11.35	278
	1978	.0004 (.99)	.01 (.01)	---	-.03 (.90)	.93 (.01)	.60 (.07)	-.46 (.10)	-.16 (.05)	.30	30.86	437
	1979	.10 (.77)	.008 (.01)	---	.42 (.25)	.31 (.01)	.26 (.34)	-.19 (.44)	-.18 (.02)	.18	15.63	434
Research to Sales Ratio (RSR)	1977	.13 (.01)	.00001 (.89)	---	-.13 (.01)	.03 (.02)	-.004 (.66)	.01 (.66)	.0001 (.99)	.23	3.18	69
	1978	.07 (.09)	.00004 (.71)	---	-.05 (.31)	.01 (.21)	-.007 (.59)	.007 (.60)	-.006 (.44)	.05	0.75	90
	1979	.10 (.03)	.00003 (.77)	---	-.08 (.10)	.01 (.51)	-.01 (.34)	.02 (.33)	.000002 (.99)	.06	0.89	95

*Parenthetical value indicates the probability that the coefficient is equal to zero.

As for the other statistical results in the GSL-LOR regressions, the cost of goods sold ratio (COS) is consistently negative but also consistently insignificant. The capital-output ratio (COR) is consistently positive and consistently significant. This result seems paradoxical for it implies that the more capital used per unit of output the more manpower used per unit of output. The resolution of this paradox maybe in the definitions of both labor and capital. The labor measure includes all employees while the capital variable extends to all identifiable assets. If more appropriate definitions which related only capital used in production to production employees were used then the expected negative relationship between COR and LOR might be observed. The two size variables (NSALE for net sales and ASSET for identifiable assets) return opposite signs in each regression with NSALE being positive and ASSET being negative. Both variables are statistically significant in the 1977 and 1978 regressions but not in the 1979 regression. The last variable, WAD, distinguishes between WAD identified manufacturers and subcontractors. Although this last variable is consistently positive, it is not statistically significant in any of the regressions. As far as the explanatory power of the set of independent variables is concerned, some success is achieved at least when compared to the results presented in Chapters V and VI. The R^2 values indicate that between 20 and 32 percent of the variation in LOR is explained by the set of independent variables.

As for the impact of GSL on the order backlog ratio (OBR), the effect is positive and significant at the one percent level in all three regressions. Thus those firms with a larger proportion of their sales to the government have a higher order-backlog ratio. This suggests that

there may be delays as the government attempts to increase its acquisition of goods and services. As for the other variables in the GSL-OBR regressions, COS returns two positive signs and one negative sign but is consistently insignificant. COR is statistically significant in two of the regressions and in both of these instances the sign of the coefficient is positive. Once again the two size variables return opposite signs in each regression; NSALE is consistently positive and ASSET consistently negative. However, both variables are statistically insignificant in all cases. The WAD variable is negative in all three regressions and statistically significant in all three regressions. This means that WAD identified subcontractors have higher order-backlog ratios than WAD identified manufacturers. This then is indicative of the source of potential bottlenecks in the structure of production. The R^2 values indicate that the set of independent variables accounts for between 18 and 30 percent of the variation in the dependent variable.

Turning to the impact of GSL on the research to sales ratio (RSR), the results presented in Table 7.1 reveal that although the impact is positive in each of the three years the relationship is not statistically significant in any of the years. This research is company-sponsored rather than customer-sponsored. Thus the implication here is that government acquisition has no impact on the ratio of company-sponsored research to sales. As for the other variables in the GSR-RSR regressions, the COS variable is negative in all three years but is only statistically significant in 1977. COR is positive in all three years but it too is only significant in 1977. As is customary the two size variables again return opposite signs in each regression; NSALE being negative while ASSET is positive and both are always insignificant. The WAD

variable is negative in 1978 and positive in the other two years and is statistically insignificant in all three regressions. The R^2 values show a marked difference between years in the ability of the independent variables to explain the variation in RSR; 23 percent of the variation is explained in 1977 but only 5 percent and 6 percent in 1978 and 1979, respectively.

B. AIR FORCE SALES REGRESSIONS

Table 7.2 presents the regression results when Air Force sales (DSL) is used as an explanatory variable rather than government sales. The objective to determine the impact of this variable on the same three measures of firm behavior: LOR, OBR, and RSR. Each will be discussed in turn.

Like GSL, DSL exerts a positive effect on LOR; that is, the greater the percentage of total sales accounted for by Air Force sales the more labor intensive the firm. However, the DSL effect, unlike the GSL effect, is consistently insignificant. The remaining independent variables return a variety of mixed effects. COS is negative in all three years but is consistently insignificant. COR is positive and significant in all three years. Note again that this positive relationship between COR and LOR seems paradoxical but may be explained by the nature of the variables. NSALE and ASSET are of opposite signs in each regression and both are statistically insignificant in the 1977 and 1978 regressions. The WAD effect is positive but statistically insignificant. The R^2 values are of the same order of magnitude as those obtained in the GSL-LOR regressions (R^2 of .19 to .24).

Table 7.2

Regression Results for Labor-Output Ratio,
Order-Backlog Ratio, and Research to Sales Ratio*
Air Force Sales
All Firms

(Glossary of Variables: Appendix A)

Ratio	Year	Constant	GSL	DSL	COS	COR	NSALE	ASSET	WAD	R^2	F-RATIO	N
Labor-Output Ratio (LOR)	1977	.01 (.42)	---	.0004 (.40)	-.007 (.63)	.03 (.01)	-.07 (.05)	-.01 (.04)	.003 (.19)	.23	5.13	109
	1978	.01 (.07)	---	.00002 (.76)	-.003 (.51)	.02 (.01)	.01 (.01)	-.01 (.02)	.002 (.32)	.24	8.22	159
	1979	.01 (.01)	---	.0001 (.42)	-.003 (.22)	.01 (.01)	.002 (.40)	-.003 (.34)	.002 (.21)	.19	6.09	165
Order-Backlog Ratio (OBR)	1977	.41 (.12)	---	.02 (.01)	.16 (.59)	.06 (.62)	.34 (.34)	.15 (.57)	-.11 (.12)	.20	11.29	278
	1978	.29 (.30)	---	.01 (.01)	-.02 (.94)	.88 (.01)	.58 (.11)	-.60 (.05)	-.29 (.01)	.18	16.16	437
	1979	.16 (.66)	---	.02 (.01)	.62 (.11)	.22 (.04)	.22 (.45)	-.24 (.34)	-.25 (.01)	.10	7.65	434
Research to Sales Ratio (RSR)	1977	.13 (.01)	---	.00003 (.94)	-.14 (.01)	.03 (.02)	-.004 (.67)	.005 (.67)	.00003 (.99)	.23	3.17	69
	1978	.06 (.13)	---	.0004 (.03)	-.04 (.36)	.01 (.16)	-.01 (.45)	.01 (.46)	-.003 (.70)	.10	1.57	90
	1979	.09 (.06)	---	.001 (.03)	-.08 (.13)	.13 (.37)	-.01 (.40)	.01 (.38)	.003 (.65)	.11	1.78	95

*Parenthetical value indicates the probability that the coefficient is equal to zero.

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DSL like GSL has a consistently positive and significant impact on the order-backlog ratio. Thus defense suppliers will not be able to respond quickly to increases in the level of Air Force procurement. The remaining variables in these regressions return rather mixed results. Taking them in the order presented: (i) COS is negative once and positive twice but consistently insignificant; (ii) COR is positive in all three years and statistically significant in both 1978 and 1979; (iii) NSALE is consistently insignificant while ASSET is only significant in 1978, a year in which it exerts a negative influence on OBR; and (iv) the WAD variable is negative in all three years and statistically significant in 1978 and 1979. The R^2 values are somewhat lower than those in the GSL-OBR regressions and range from .10 to .20.

Although GSL did not exert any significant impact on the research to sales ratio (RSR), DSL does. In each regression DSL exerts a positive influence which in 1978 and 1979 is statistically significant. It is difficult to determine whether this positive relationship between DSL and RSR is cause or effect, that is, whether the nature of the products acquired by the Air Force are such that heavy company-sponsored research expenditures are necessary or if substantial in-house research is an a priori condition for the attainment of Air Force contracts. The remaining variables in the DSL-RSR regressions return mixed results. The COS variable is negative in all three years but statistically significant only in 1977. The COR ratio is positive in all three regressions indicating that research is a captial intensive activity. However, COR is only statistically significant in the 1977 regression. The two size variables return the usual opposite sign pattern; NSALE being negative and ASSET being positive, but both variables are statistically insignif-

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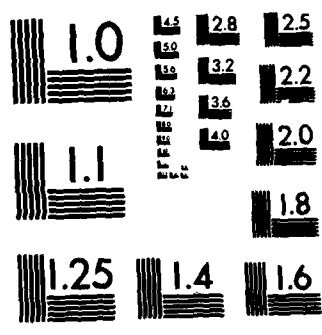
MICROCOPY RESOLUTION TEST CHART

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icant in each regression. The WAD variable is consistently insignifi-
cant. The overall explanatory power of these regressions is on the same
order of magnitude as those obtained in the DSL-OBR regressions and
superior to those obtained in the GSL-RSR regressions. They now range
from .10 to .23.

C. SUMMARY AND CONCLUSIONS

To be as concise as possible it is useful to restate the results in
a question and answer format.

1. What is the impact of sales to the government on the labor-
    output ratio of corporate segments in the aerospace industry?

    The regression results show a positive and generally signifi-
    cant impact.

2. What is the impact of sales to the government on the order-
    backlog ratio of corporate segments in the aerospace industry?

    The impact as revealed by the regression analysis is consis-
    tently positive and significant.

3. What is the impact of sales to the government on the research
    to sales ratio of corporate segments in the aerospace indus-
    try?

    The impact is positive but statistically insignificant.

4. What is the impact of sales to the Air Force on the labor-
    output ratio of corporate segments in the aerospace industry?

    The impact is positive but statistically insignificant.

5. What is the impact of sales to the Air Force on the order-
    backlog ratio of corporate segments in the aerospace industry?

    The impact is consistently positive and significant. Conse-
    quently an effort to acquire increased output from Air Force
    suppliers is likely to meet delays.

6. What is the impact of sales to the Air Force on the research
    to sales ratio of corporate segments operating in the aero-
    space industry?

    The impact is consistently positive and generally significant.
    Thus, either as a prerequisite to the attainment of an Air
    Force contract or as a consequence, Air Force suppliers tend
    to be more research intensive.

CHAPTER VIII.   PHASE II SUMMARY AND COMPARISON WITH PHASE I

The purpose of this chap er is to provide a convenient summary of the analysis presented in the preceding chapters, a summary of the investigation of the behavior of the approximately 1000 public corporate segments in the aerospace industry. In addition, the conclusions drawn in the Phase II research are compared to those drawn in Phase I. Phase I dealt with consolidated corporations and with the comparison of Phase I and Phase II results allows an assessment of whether behavior at the consolidated corporation level is duplicated at the corporate segment level. Since the methodology is statistically more powerful, the discussion is limited to the results generated by the regression analysis. The order of presentation will be the same as in the body of this report.

A.   PROFITABILITY

The analysis presented in Chapter IV indicates that no single simple statement can be made regarding the relationship between government sales and Air Force sales on the one hand and profitability on the other. Rather, conclusions depend on the measure of profitability (profitability criterion), on whether the focus is on government or Air Force sales, and on the manner in which the sample of firms is selected. Thus, there is no statistically significant relationship between the profit

margin ratio and the proportion of a firm's total sales that are made to the government or the profit margin ratio and the proportion of a firm's total sales that are made to the Air Force. But the greater the proportion of government sales the higher is the rate of return on investment. The same can be said of the relationship between Air Force sales and the rate of return on investment if the sample of firms is restricted to the SIC 3000-3999 code classifications.

These conclusions are somewhat in contradiction to those drawn in Phase I where consolidated corporations rather than corporate segments constituted the unit of analysis. The Phase I analysis suggested the general conclusion that the proportion of a consolidated firm's total sales going to the government was not related in any statistically significant manner to any of five measures of profitability.

B. EFFICIENCY

The conclusions drawn in Chapter V are also sensitive to the measure of efficiency and the government-Air Force focus. There is no statistically significant relationship between either government sales or Air Force sales and the cost of goods sold ratio. There is also no statistically significant relationship between Air Force sales and the capital-output ratio. However, firms with higher proportions of government sales have significantly lower capital-output ratios. Note that these conclusions are not sensitive to the distinction between all public aerospace firms and those in the SIC 3000-3999 code classifications.

The conclusion of an inverse relationship between government sales and the capital-output ratio was also revealed in the Phase I research;

that is, the Phase I and Phase II capital-output ratio results are consistent. The Phase I research suggested a positive relationship between government sales and the cost of goods sold ratio while the Phase II research does not reveal or suggest the same type of generality of inefficiency for government and Air Force suppliers as the Phase I research.

C. CAPITAL MANAGEMENT

In the case of capital management aspects of firm behavior, the results presented in Chapter VI indicate that conclusions tend to be sensitive to the measure of capital management and to the manner in which the sample of firms is selected but not sensitive to the distinction between government sales and Air Force sales. With respect to the broader sample of firms there is no statistically significant relationship between either government sales or Air Force sales and any of the three measures of capital management. When the analysis is limited to those firms in the SIC 3000-3999 code classifications there is a statistically significant relationship between both government sales and Air Force sales on the one hand and both the gross replacement ratio and the net replacement ratio measures of capital management on the other. As for the nature of these relationships, firms with greater proportions of government and Air Force sales tend to have higher gross and net replacement ratios.

As for comparisons of Phase I and Phase II conclusions, none are possible. This is the case because the three measures of capital management are unique to Phase II.

D. OTHER MEASURES OF FIRM BEHAVIOR

Chapter VII represented an evaluation of the relationships between government sales and Air Force sales and three other measures of firm behavior. This evaluation was limited to a much smaller number of firms because of data constraints and no effort was made to complete a separate analysis for firms in the SIC 3000-3999 code classifications. A summary of these results and a comparison with Phase I results can be stated quite specifically:

(i) Government sales generally imply higher labor-output ratios. This is in accord with the results obtained in the Phase I analysis.

(ii) Higher proportions of government sales and Air Force sales do lead to statistically significant higher order-backlog ratios. This conclusion is fully in accord with the Phase I results.

(iii) Government sales do not have a statistically significant impact on the research to sales ratio but higher proportions of Air Force sales do lead to statistically significant higher research to sales ratios. The conclusion from Phase I was more in accord with this latter finding.

E. OVERALL CONCLUSIONS

As to whether significant differences arise between the behavior of firms doing business with the government and the Air Force and those that do not, it would appear that conclusions depend on several considerations. One consideration is the area of firm behavior being exam-

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ined - profitability, capital management, efficiency, etc. A second consideration is the particular aspect within the area of firm behavior. For example, there is some sensitivity in conclusions within the profitability area depending on whether the profit margin ratio or return on investment is used as the profitability criterion. A third consideration is whether the focus is on government sales or Air Force sales; what may be true of the more general case (government sales) may not be true of the less general case (Air Force sales). A fourth consideration is the selection of firms. This was evidenced by the fact that conclusions in certain areas and for particular measures of firm behavior did change when the sample was changed from all firms to just the firms in the SIC 3000-3999 industries. A fifth consideration is the fact that the conclusions were somewhat sensitive to the methodology employed; the test for differences in average behavior yielded a result which did not agree with that obtained from the regression analysis. In these cases we have deferred to the stronger methodology - the regression analysis. This leads to the sixth and last consideration and it concerns the fact that data limitations have precluded the use of variables that may be very important in explaining the behavior of some particular aspect of firm behavior. This is evidenced by low values for the coefficient of determination. Reworded, the inclusion of more explanatory variables could increase the explanatory power of the regression equation in certain instances and may, thereby, alter the sign and statistical significance of the GSL and DSL variables.

With this list of qualifications in mind, the conclusions drawn in the Phase II analysis with respect to Air Force sales (DSL) can be summarized as follows:

(i) no statistically significant relationship between DSL and profitability;

(ii) no statistically significant relationship between DSL and efficiency;

(iii) no statistically significant relationship between DLS and capital management;

(iv) no statistically significant relationship between DLS and the labor output ratio; and

(v) increases in DSL are associated with statistically significant increases in the order-backlog and the research to sales ratio.

Thus it would appear that if the intent of Air Force acquisition procedures is not to create any difference between suppliers and non-suppliers, then these procedures have, in general, been successful. Still if the Air Force attempts a rapid increase in the pace of acquisitions, it likely to encounter delays.

F. FUTURE RESEARCH

As far as future research activity is concerned, two basic tasks remain. The first is to extend the analysis from the consolidated corporations of Phase I and the corporate segments of Phase II to the sub-contractors in the aerospace industry. Clearly the viability of the defense industry depends on the economic well being of these firms as well as the financial health of corporate segments and their consolidated corporate parents. The major difficulty in conducting such re-

search is the fact, stated in Chapter I, that subcontractors appear to be predominately private firms and data on economic performance is not immediately available. In extending research to the subcontracting firms the search for data becomes a critical element.

The second major task for future research concerns a more detailed analysis of why the patterns isolated in Phase I and Phase II occur. Take for example the finding that Air Force suppliers have statistically significantly higher order-backlog ratios. Is this because they have reduced capacity as indicated by lower capital output ratios or is it because they are reacting to the one year contracting process by forcing the Air Force to accept potentially longer delays in the delivery of products? More simply put, the Phase I and Phase II research has concentrated more heavily on the "what is" aspects of firm behavior and less heavily on the "why it is" aspects. Once the "what is" aspects of subcontractors have been isolated then explanations and integration of the separate analyses can be accomplished.

APPENDIX A

GLOSSARY OF VARIABLE NAMES

Appendix A

Glossary of Variable Names

ROI = return on investment measured as the ratio of operating profits to identifiable assets.

PMR = profit margin ratio measured as the ratio of operating profits to net sales.

COS = cost of goods sold ratio measured as the ratio of the difference between net sales and operating profits to net sales.

COR = capital output ratio measured as the ratio of identifiable assets to net sales.

LOR = labor-output ratio measured as the ratio of employees to net sales.

GRR = gross replacement ratio measured as the ratio of capital expenditures to identifiable assets.

NRR = net replacement ratio measured as the ratio of the difference between capital expenditures and depreciation to identifiable assets.

CAPCNG = capital change ratio measured as the ratio of capital expenditures to depreciation.

NSALE = net sales.

ASSET = identifiable assets.

GSL = percent of a firm's net sales accounted for by government sales.

DSL = percent of a firm's net sales accounted for by sales to the Air Force.

WAD = World Aviation Directory classification with a '0' for subcontractor and a '1' for manufacturers.

COGS = cost of goods sold measured as the difference between net sales and operating profits.

OBR = order-backlog ratio measured as the ratio of order-backlog to net sales.

RSR = research to sales ratio measured as the ratio of company sponsored research to net sales.

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APPENDIX B

CORPORATE STRUCTURE

Appendix B

Structure of Teledyne Incorporated

In 1979 Teledyne Incorporated (CUSIP # 879335) was divided into five corporate segments:

    1   Industrial Products and Services

    2   Aviation and Electronics

    3   Specialty Metals

    4   Consumer Products and Services

    5   Insurance and Finance

In addition, Teledyne Incorporated was also divided into plants and divisions as noted below. The financial information on the sum of the appropriate individual plants constitute the segment information. For example Packard Bell Electronics, Packard Bell Electronics Corporation, Ryan Aeronautical Company Incorporated, and Teledyne Avionics are all part of the Aviation and Electronics segment.

Abco Die Casting
Abco Die Casting Corporation
Acoustic Control Corporation
Acoustic Research
Crystalonics Incorporated
EIL Instruments Incorporated
Electro Mechanisms Incorporated
Farris Engineering Corporation
Firth Sterling
Frederick Post Company
Frederick Post Company Incorporated
H & H Tool Division
Hastings Raydist Incorporated
Irby Steel Company Incorporated
Lectro Cast Division Teledyne
McCormick Selph
Merla Incorporated
Metal Finishers Incorporated
Mt. Vernon Die Casting
Packard Bell Electronics
Packard Bell Electronics Corporation
Penn Union Electric
Phoenix Job Corps Center
Pittsburgh Tool Steel
Portland Forge Incorporated
Power Tronic Systems Incorporated
Ryan Aeronautical Company Incorporated
Standard Collapsible Tube
Surface Chemicals
Teledyne Aero Cal
Teledyne Aerospace Systems
Teledyne Amco
Teledyne Analytica
Teledyne Ansonia Mfg.
Teledyne Avionics
Teledyne AWD
Teledyne Battery Products
Teledyne Big Beam
Teledyne Brown Engineering
Teledyne CAE
Teledyne Camera Systems
Teledyne Cast Products
Teledyne Casting
Teledyne Casting Service
Teledyne Canonsburg
Teledyne Columbia-Sumerhil
Teledyne Continental Casting
Teledyne Continental Motor
Teledyne Continental Motors
Teledyne Crittenden
Teledyne-Densco
Teledyne Dental
Teledyne Dental/Blu White

Teledyne Dyno Power
Teledyne Efficient Inds
Teledyne Exploration
Teledyne Exploration Company
Teledyne Extrusion Corporation
Teledyne/Firth Sterling
Teledyne Goetech
Teledyne Gurley
Teledyne Hanau
Teledyne Hastings Raydist
Teledyne-Howell Penncraft
Teledyne Howell-Penncraft
Teledyne Incorporated
Teledyne Incorporated/Prec C
Teledyne Industrial Die Cast
Teledyne Industries Incorporated
Teledyne Inet
Teledyne Isotopes Energy Systems
Teledyne Isotopes Incorporated
Teledyne Kinetics
Teledyne Laars
Teledyne Landis Machine
Teledyne Lewisburg
Teledyne Linair
Teledyne McKay
Teledyne MEC
Teledyne Mecca
Teledyne Merla
Teledyne Metal Finishers
Teledyne Metal Forming
Teledyne Micromatic
Teledyne Monarch
Teledyne Mono-Thane
Teledyne Movible Offshore
Teledyne Natl Tracing Paper
Teledyne Neosho
Teledyne Ohio Cast Division
Teledyne Ohio Steel
Teledyne Osco Steel
Teledyne Oster Div
Teledyne Owen
Teledyne Packaging
Teledyne/Peer
Teledyne Pines
Teledyne Pipe
Teledyne Positiv Connectr
Teledyne Post
Teledyne Raadco
Teledyne Relays
Teledyne-Republic M
Teledyne Rodney Metals
Teledyne Rotolite Company
Teledyne Semiconduc
Teledyne Sprague Engineering

Teledyne Still-Man Mfg Company
Teledyne Systems
Teledyne Systems Company
Teledyne Systems Corporation
Teledyne Taber Corporation
Teledyne-Tack
Teledyne Titanium
Teledyne Vasco
Teledyne Vasco/Mid-America
Teledyne Wah Chang
Teledyne Water Pik
Teledyne Wisconsin Motor
Thermatics Incorporated
Turner Tube Corporation
Vasco Metals Corporation
Wah Chang Corporation
Wirz A H Incorporated
Wirz Teledine

APPENDIX C

CONSOLIDATED CORPORATIONS INCLUDED IN DATABASE

FOR PHASE II ANALYSIS

(1979)

CUSIP NO.	CORPORATION NAME	SIC CODE
361	AAR CORP.	5080
1030	AEL INDS.	3662
1688	AMF INC.	3940
2080	A-T-O INC.	3560
7500	ADVANCE ROSS CORP.	3728
7842	AERONCA INC.	3728
9158	AIR PRODUCTS & CHEMICALS INC.	2810
12347	ALBANY INTL. CORP.	2200
13788	ALCO STANDARD CORP.	5199
16509	ALL AMERICAN INDUSTRIES INC.	3449
17372	ALLEGHENY LUDLUM INDS.	3310
17634	ALLEN GROUP	3714
19645	ALLIS-CHALMERS CORP.	3531
22249	ALUMINUM CO. OF AMERICA	3350
23519	AMERACE CORP.	3000
23852	AMERICAN APPRAISAL ASSOC. INC.	6500
29429	AMERICAN SCIENCE ENGINEERING	3811
30710	AMERON INC.	3270
31105	AMETEK INC.	3811
31897	AMP INC.	3640
32172	AMSTAR CORP.	2062
32177	AMSTED INDUSTRIES	3740
32654	ANALOG DEVICES	3679
33047	ANCHOR HOCKING CORP.	3221
34393	ANDREA RADIO CORP.	3662
34663	ANGELICA CORP.	2300
38177	APPLIED DEVICES	7370
42170	ARMCO INC.	3310
42627	ARO CORP.	3560
43339	ARVIN INDUSTRIES INC.	3714
43413	ASARCO INC.	1000
49267	ATLAS CORP.	1000
53501	AVCO CORP.	9997
57068	BAIRD CORP.	3830
58498	BALL CORP.	3221
60221	BANGOR PUNTA CORP.	3721
66545	BANNER INDUSTRIES INC.	4210
67419	BARDEN CORP.	3560
67797	BARNES ENGINEERING CO.	3662
69779	BASE TEN SYSTEMS INC.	3662
75815	BECKMAN INSTRUMENTS INC.	3811
75887	BECION, DICKINSON & CO.	3841
78107	BELL INDUSTRIES INC.	5065
81689	BENDIX CORP.	3714
87509	BETHLEHEM STEEL CORP.	3310
89671	BIG THREE INDUSTRIES	3533
93545	BLISS & LAUGHLIN INDS.	3310
97023	BOEING CO.	3721

CUSIP NO.	CORPORATION NAME	SIC CODE
97689	BOLT BERANEK & NEWMAN INC.	7370
99725	BORG-WARNER CORP.	3714
103025	BOWMAR INSTRUMENT CORP.	3820
106763	BREEZE CORP.	3429
114331	BROOKS & PERKINS INC.	3449
117043	BRUNSWICK CORP.	3510
120547	BUNDY CORP.	3310
120655	BUNKER RAMO CORP.	3670
121691	BURLINGTON INDUSTRIES INC.	2200
122205	BURNDY CORP.	3679
122781	BURROUGHS CORP.	3570
123720	BUTLER NATIONAL CORP.	3662
124884	CCI CORP.	3713
127055	CABOT CORP.	3350
131069	CALLAHAN MINING CORP.	1000
142339	CARLISLE CORP.	3000
144285	CARPENTER TECHNOLOGY	3310
149123	CATERPILLAR TRACTOR CO.	3531
157177	CESSNA AIRCRAFT CO.	3721
158663	CHAMPION SPARK PLUG	3699
163852	CHEMPLAST INC.	3079
171196	CHRYSLER CORP.	3711
177846	CITY INVESTING CO.	9997
182702	CLAROSTAT MANUF. CO. INC.	3670
192576	COHU INC.	3662
194162	COLGATE-PALMOLIVE CO.	2841
196864	COLT INDUSTRIES INC.	9997
205826	COMTECH TELECOMMUNICATION CORP.	3662
206741	CONDEC CORP.	3494
208291	CONRAC CORP.	3662
210012	CONSOLIDATED REFINING	3350
211452	CONTINENTAL GROUP	3410
212363	CONTROL DATA CORP.	3570
224399	CRANE CO.	3310
227813	CROUSE-HINDS CO.	3610
229669	CUBIC CORP.	3662
231561	CURTISS-WRIGHT CORP.	3560
232147	CUTLER FEDERAL INC.	3499
232525	CYCLOPS CORP.	3310
233108	DCL INC.	7370
235811	DANA CORP.	3714
237649	DATA DESIGN LABORATORIES	3679
239577	DAYCO CORP.	3000
250595	DE SOTO INC.	2850
252165	DEXTER CORP.	2890
252741	DIAMOND SHAMROCK CORP.	2800

CUSIP NO.	CORPORATION NAME	SIC CODE
257651	DONALDSON CO. INC.	3714
260003	DOVER CORP.	3550
262093	DRIVER HARRIS CO.	3350
263534	DU PONT (E.I.) DE NEMOURS	2800
263566	DUAL LITE INC.	3640
264147	DUCOMMUN INC.	5050
267813	DYNALECTRON CORP.	1700
268039	DYNAMICS CORP. OF AMERICA	3630
268075	DYNASCAN CORP.	3662
268163	DYNEER CORP.	3714
268226	EAC INDUSTRIES	3429
268420	EECO INC.	3679
268457	EG & G INC.	8911
269157	E-SYSTEMS INC.	3662
269803	EAGLE-PICHER INDS.	3550
277461	EASTMAN KODAK CO.	3861
278058	EATON CORP.	3714
279029	ECONOMICS LABORATORY INC.	2841
281347	EDO CORP.	3662
285551	ELECTRONIC ASSOCIATES INC.	3573
285744	ELECTRONIC MEMORIES & MAGNET	3573
285821	ELECTRONIC RESEARCH ASSOC.	3679
286065	ELECTRONIC CORP. OF AMERICA	3622
286434	ELGIN NATIONAL INDUSTRIES	1600
291011	EMERSON ELECTRIC CO.	3600
291210	EMHART CORP.	3550
296659	ESQUIRE INC.	3640
297425	ESTERLINE CORP.	3540
300587	EX-CELL-CO CORP.	3540
302491	FMC CORP.	2800
303032	FACET ENTERPRISES	3714
303711	FAIRCHILD INDUSTRIES INC.	3720
313549	FEDERAL-MOGUL CORP.	3714
313819	FEDERAL SCREW WORKS	3452
315405	FERRO CORP.	2890
318315	FIRESTONE TIRE & RUBBER CO.	3000
338027	FISHER SCIENTIFIC CO.	3811
339423	FLIGHTSAFETY INTERNATIONAL	8200
343465	FLOW GENERAL INC.	7391
350897	FOUR-PHASE SYSTEMS	3573
351604	FOXBORO CO.	3823
359370	FRUEHAUF CORP.	3714
361428	GAF CORP.	2950
361556	GCA CORP.	3550
362360	GTI CORP.	3679
367410	GATES LEARJET CORP.	3721
369550	GENERAL DYNAMICS CORP.	3721

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CUSIP NO.	CORPORATION NAME	SIC CODE
369604	GENERAL ELECTRIC CO.	3600
370118	GENERAL INSTRUMENT CORP.	3670
370442	GENERAL MOTORS CORP.	3711
370790	GENERAL SEMICONDUCTOR INDS.	3670
370838	GENERAL SIGNAL CORP.	3823
371028	GENERAL TELEPHONE & ELECTRONICS	4811
371352	GENERAL TIRE & RUBBER CO.	3000
372298	GENISCO TECHNOLOGY	3573
382388	GOODRICH (B.F.) CO.	3000
382550	GOODYEAR TIRE & RUBBER CO.	3000
383082	GORMAN-RUPP CO.	3560
383492	GOULD INC.	3610
384109	GRACO INC.	3560
390568	GREAT LAKES CHEMICAL CORP.	2810
399820	GROW GROUP INC.	2850
400181	GRUMMAN CORP.	3721
402064	GULF & WESTERN INDS. INC.	9997
402784	GULTON INDUSTRIES INC.	3651
404245	HMW INDUSTRIES INC.	3480
406216	HALLIBURTON CO.	1600
413875	HARRIS CORP.	3662
415864	HARSCO CORP.	3341
421596	HAZELTINE CORP.	3573
422174	HEALTH-CHEM CORP.	5080
423038	HEINICKE INSTRUMENTS	3811
428290	HEXCEL CORP.	3499
428399	HI-SHEAR INDUSTRIES	3452
438506	HONEYWELL INC.	3573
440443	HORIZONS RESEARCH INC.	3861
449268	IC INDUSTRIES INC.	4011
449680	IMC MAGNETICS CORP.	3560
456830	INFRARED INDUSTRIES INC.	3830
458140	INTEL CORP.	3670
458542	INTERCONTINENTAL DYNAMICS	3811
458702	INTERLAKE INC.	3310
458776	INTERMARK INC.	5065
459200	INTL. BUSINESS MACHINES CORP.	3570
459362	INTL. CONTROLS CORP.	3728
459578	INTL. HARVESTER CO.	3711
460254	INTL. RECTIFIER CORP.	3679
460470	INTL. TELEPHONE & TELEGRAPH	9997
460701	INTERSEL INC. NEW	3670
465632	ITEK CORP.	3550
470448	JAMESBURY CORP.	3494
478358	JOHNSON (E.F.) CO.	3662
480827	JORGENSEN (EARLE M.) CO.	5050

CUSIP NO.	CORPORATION NAME	SIC CODE
481070	JOSLYN MFG & SUPPLY CO.	3610
481196	JOY MFG CO.	3550
482452	K.D.I. CORP.	5199
483548	KAMA N CORP-CL A	5080
486026	KATY INDUSTRIES	9997
493782	KIDDE INC.	9997
495620	KING RADIO CORP.	3662
500440	KOLLMORGEN CORP.	3622
500602	KOPPERS CO.	2860
500759	KRATOS INC.	3823
501858	LFE CORP.	3823
502210	LTV CORP.	9997
502470	LA BARGE INC.	3310
513696	LAMSON & SESSIONS CO.	3740
515804	LANGLEY CORP.	3499
521894	LEAR SIEGLER INC.	3714
530000	LIBBEY-OWENS-FORD CO.	3210
536257	LIONEL CORP.	5999
536308	LIPE ROLLWAY CORP.	3714
538021	LITTON INDUSTRIES INC.	9997
539821	LOCKHEED CORP.	3720
543859	LORAL CORP.	3662
550374	LUNDY ELECTRONICS & SYSTEMS	3573
551137	LYNCH CORP.	3679
556096	MACRODYNE INDS.	3728
570387	MARK IV INDUSTRIES INC.	2450
573275	MARTIN MARIETTA CORP.	3760
574599	MASCO CORP.	3430
576680	MATERIALS RESEARCH	3560
577377	MAUL TECHNOLOGY CORP.	3550
580169	MCDONNELL DOUGLAS CORP.	3721
580628	MCGRAW-EDISON CO.	3610
582562	MCNEIL CORP.	3560
591503	METEX CORP.	3499
595067	MICRODYNE CORP.	3662
597715	MIDLAND-ROSS CORP.	3320
600544	MILLER (HERMAN) INC.	2520
602720	MINE SAFETY APPLIANCES CO.	3841
604059	MINNESOTA MINING & MFG CO.	3861
606708	MITE CORP.	3429
608030	MOHASCO CORP.	2510
609762	MONOGRAM INDUSTRIES INC.	3079
615394	MOOG INC. - CL A	3662
620076	MOTOROLA INC.	3662
629156	NL INDUSTRIES	3533
630871	NARDA MICROWAVE CORP.	3679

CUSIP NO.	CORPORATION NAME	SIC CODE
636418	NATIONAL HOMES CORP.	2450
637215	NATIONAL PPESTO INDS. INC.	3630
637657	NATIONAL SERVICE INDS. INC.	3640
637844	NATIONAL STEEL CORP.	3310
656389	NORRIS INDUSTRIES INC.	3714
657045	NORTH AMERICAN PHILIPS CORP.	3600
666807	NORTHROP CORP.	3720
668605	NORTON CO.	3290
670826	OEA INC.	3728
671400	OAK INDUSTRIES INC.	3679
672206	OAKITE PRODUCTS	2841
680665	OLIN CORP. .	2800
683816	OPTEL CORP.	5331
683836	OPTICAL RADIATION	3640
690020	OUTBOARD MARINE CORP.	3510
693506	PPG INDUSTRIES INC.	2800
694806	PACIFIC SCIENTIFIC CO.	3550
695462	PAGE AIRWAYS INC.	5080
696429	PALL CORP.	3560
701094	PARKER-HANNIFIN CORP.	3560
704562	PEABODY INTERNATIONAL CORP.	3558
709352	PENRIL CORP.	3651
714041	PERKIN-ELMER CORP.	3811
717265	PHELPS DODGE CORP.	1021
718009	PHILADELPHIA SUBURBAN CORP.	7394
723886	PIONEER SYSTEMS INC.	2300
727491	PLANTRONICS INC.	3661
729110	PLESSEY CO. LTD.	3662
730196	PNEUMO CORP.	5411
736202	PORTEC INC.	3531
736245	PORTER (H.K.) INC. - DEL	3310
746299	PURITAN-BENNETT CORP.	3841
746384	PUROLATOR INC.	7393
747620	QUANEX CORP.	3310
749285	RCA CORP.	3651
750633	RAGEN PRECISION INDS.	3499
751874	RAMTEX CORP.	3573
754212	RAVEN INDUSTRIES INC.	2300
754603	RAYCHEM CORP.	3079
754713	RAYMOND INDUSTRIES INC.	3480
755111	RAYTHEON CO.	3662
758655	REFAC TECHNOLOGY DEV. CP.	3679
758854	REGENCY ELECTRONICS INC.	3662
760354	REPUBLIC CORP.	3449
760779	REPUBLIC STEEL CORP.	3310
761688	REXNORD INC.	3560

CUSIP NO.	CORPORATION NAME	SIC CODE
770519	ROBERTSHAW CONTROLS	3820
770553	ROBERTSON (H.H.) CO.	3449
772887	ROCKCOR INC.	3728
774347	ROCKWELL INTERNATIONAL CORP.	3714
774846	RODALE ELECTRONICS INC.	3662
775422	ROHR INDUSTRIES	3728
775784	ROLM CORP.	3573
776338	RONSON CORP.	3630
783890	SCI SYSTEMS INC.	3811
784197	SGL INDUSTRIES INC.	3699
784626	SPS TECHNOLOGIES INC.	3452
784719	SSP INDUSTRIES	3728
799850	SANDERS ASSOCIATES INC.	3662
803666	SARGENT INDUSTRIES INC. - CA.	3499
808655	SCIENTIFIC-ATLANTA INC.	3825
809367	SCOTT & FETZER CO.	3560
817698	SERVO CORP. OF AMERICA	3662
817732	SERVOTRONICS INC.	3429
826520	SIERRACIN CORP.	3728
826622	SIGNAL COS.	9997
827079	SILICONIX INC.	3679
828675	SIMMONDS PRECISION PRODS. INC.	3823
829302	SINGER CO.	3630
833034	SNAP-ON TOOLS CORP.	3429
847235	SPARION CORP.	3670
847567	SPECTRA-PHYSICS	3811
848355	SPERRY CORP.	3573
854497	STANLEY AVIATION CORP.	3728
859281	STERLING ELECTRONICS	5065
860163	STEVEN (J.P.) & CO.	2200
860342	STEWART & STEVENSON SERVICES	3510
860486	STEWART-WARNER CORP.	3560
866713	SUN ELECTRIC CORP.	3825
867017	SUNAIR ELECTRONICS INC.	3662
867323	SUNDSTRAND CORP.	3560
868358	SUPERIOR SURGICAL MFG.	2300
870326	SWEDLOW INC.	3079
872628	TRE CORP.	3429
872649	TRW INC.	3714
874687	TALLEY INDUSTRIES INC.	3870
875884	TANNETICS INC.	3580
878308	TECH-SYM. CORP.	3679
878708	TECHNOLOGY INC.	3449
879335	TELEDYNE INC.	9997
879369	TELEFLEX INC.	3714
879573	TELEX CORP.	3573

CUSIP NO.	CORPORATION NAME	SIC CODE
880345	TENNANT CO.	3580
880625	TENNEY ENGINEERING INC.	3560
882508	TEXAS INSTRUMENTS INC.	3670
883203	TEXTRON INC.	9997
884102	THIOKOL CORP.	3760
884315	THOMAS & BETTS CORP.	3679
892348	TRACOR INC.	3662
893889	TRANSTECHNOLOGY CORP.	3480
896726	TRION INC.	3560
902120	TYCO LABORATORIES INC.	3560
902878	UMC INDUSTRIES	3580
905581	UNION CARBIDE CORP.	2800
906072	UNION CORP.	9997
907770	UNION OIL CO. OF CALIFORNIA	2911
909160	UNIROYAL INC.	3000
909313	UNITED AIRCRAFT PRODUCTS INC.	3728
910671	UNITED INDUSTRIAL CORP.	3811
912656	U.S. STEEL CORP.	3310
913017	UNITED TECHNOLOGIES CORP.	3728
913283	UNITRODE CORP.	3670
918314	VSI CORP.	3540
922204	VARIAN ASSOCIATES INC.	3670
922272	VARO INC.	3670
924359	VERNITRON CORP.	3679
928298	VISHAY INTERTECHNOLOGY INC.	3825
930183	WADELL EQUIPMENT CO.	3540
932355	WALLACE-MURRAY CORP.	3430
934459	WARNER ELEC BRAKE & CLUTCH	3622
942486	WATKINS-JOHNSON	3662
949732	WELLS BENRUS CORP.	3560
958264	WESTERN GEAR CORP.	3728
960402	WESTINGHOUSE ELECTRIC CORP.	3600
962898	WHEELABRATOR-FRYE	3558
963626	WHITE CONSOLIDATED INDS. INC.	3630
965010	WHITEHALL CORP.	3811
966680	WHITTAKER CORP.	9997
983051	WYLE LABORATORIES	5065
983085	WYMAN-GORDON CO.	3499