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AEROSPACE ECONOMIC FORECAST 1971-1980

RESEARCH REPORT

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AEROSPACE ECONOMIC FORECAST 1971-1980

A Research Report of

AEROSPACE RESEARCH CENTER

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CONTENTS

CONTENTS OF TABLES

1

INTRODUCTION

The aerospace industry today is beset with uncertainty as to whether its future is destined to carry more of its recently troubled past, or whether some return to the vigorous growth days of the middle sixties lies ahead in the rest of the decade. This study seeks to project the industry's probable market future as a partial answer to these concerns. By intention, the study is demand-oriented. That is, it seeks to derive aerospace market dimensions from the need or customer side. It does not address the industry or individual firm conditions that may or may not stand opposite these projected demands.[1]

A previous study[2] has examined the aerospace industry's contribution to the national economy, as well as a number of problems the industry has encountered as both national economic and governmental priorities have shifted in recent years. From a position of growth in response to strong demands in defense, space, and commercial aircraft markets, the industry has been forced to curtail and reduce much of its productive capacity in equipment, facilities, and people to

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1. Appendix B, "Analysis of Selected Industry Variables and their Interactions," examines a number of statistically derived "supply-side" factors that, with further analysis, might permit projections of industry conditions.

2. Aerospace and the United States Economy: Its Role, Contributions, and Critical Problems. Aerospace Industries Association, November 1971.

levels approximating those of the earlier sixties. From its former role as the largest employer of scientists and engineers and, by that, the foremost representative of R&D and high technology elements in the nation's output, the industry has lately seen its capacity substantially reduced.

Impacts have been felt, also, in other areas. Aerospace exports, for example, have long been a substantial part of the industry's output and have contributed in a major way to the country's positive trade balances for many years. This advantage is now under serious threat by foreign competitors.

If aerospace is to effectively contribute to national purposes and needs, it is important to form some sense of the market opportunities against which it conventionally operates, as well as emerging market areas in which its skills and capacities can be constructively applied. This study is intended to assess the probable future dimensions of both these conventional and emerging markets.

The natural point of departure for analyzing and developing the future profile of an industry is at the level of the total economy in which the industry operates. While aggregate economic activity reveals little specific about the economics and outlook of any given industry, the aggregate measures of an economy are necessary as an overall controlling framework. This is especially relevant to the aerospace industry that has as its major customer the U.S. Federal Government.

The presentation of the projections begin with the U.S. economy and the major component parts--personal consumption expenditures, gross private domestic investment, net exports, and government expenditures for goods and services. Together these four components add to the Gross National Product of the nation. Each component, in turn, is discussed.

Projections of future demand for aerospace products begins with an analysis of future defense and space expenditures. Demand for commercial air transports, general aviation products, parts, accessories and equipment for aircraft, and non-aerospace products make up the total private aerospace sector.

A FEW WORDS ABOUT PROJECTIONS

Projections or forecasts--the terms are used interchangeably--are a form of art rather than a science. They look to the past for data and trends from which emerge a set of assumptions for developing a forecast. If the future proves the assumptions incorrect, then the projections will be wrong, unless, of course, by chance they could be correct, but for the wrong reason. The correctness of the underlying assumptions, unfortunately, cannot be tested by scientific procedures.

There are two general approaches for developing projections or forecasts:

(1) projecting aggregate characteristics that are then divided into sub-aggregates according to assumed proportions or relationships among the whole and its parts, or

(2) projecting characteristics by individual entity and then combining these to derive the wholes.

In general, data series and sources used for approach (1) seem to have relatively high validity and credibility for more aggregated levels of projection. But these virtues decline as the statistics are derived for smaller and smaller sub-parts. Conversely, approach (2) seems to have more validity at the lower, sub-unit end of the spectrum; but as summations and aggregations are made, the characteristics seem to square less and less with reality for the larger wholes.

While there are a number of technical explanations for these tendencies, a more common-sense interpretation is that approach (2) typically assumes independence of the trends ascribed to the small units; when aggregated for some future point, these "independent" effects tend to be compounded and thus to overstate the whole. Approach (1), on the other hand, may implicitly incorporate interdependencies in the aggregated projections, but in parcelling out the total among the parts for the projected point in time, some fixed functional relationship must be assumed. This typically ascribes interdependencies to the small units that may or may not be valid.

The projections made for this study followed the top down technique of approach (1). The projections, however, are tempered wherever possible by specific details of the type that would form the data base for projections by approach (2).

Before proceeding with the projections, a few notes are required:

(1) The projections were developed from an aggregate top-down methodology and then adjusted for specific items of detail where they were known. It must be acknowledged that important items of detail may not have been uncovered by the research and, of course, were therefore not included. Paying this price was deemed more acceptable than building up from the detail and taking the risk that an important item of detail would be overlooked.

(2) In actuality, year-to-year variations do occur--the past data is resplendent with level-offs, dips, and surges. In making the projections, these were smoothed over, as the overall objective was to develop the most reasonable magnitude and trend.

(3) All projections have been rounded to the most significant digits. Long strings of numbers do not add meaning to forecasts.

(4) All projections are for calendar years. The base years shown for defense and space expenditures were adjusted from the government fiscal year base to a calendar year base.

2

GROSS NATIONAL PRODUCT TO 1980

Projections of the U.S. economy for the 1970-1980 time frame are presented in this section. GNP--the annual dollar value of all goods and services produced and sold by the United States--contains four major components: personal consumption expenditures, gross private domestic investment, total government expenditures for goods and services,[1] and net exports.

In 1970 the GNP was $974.1 billions composed of:

Personal Consumption	$615.8
Government Expenditures	219.4
Gross Domestic Private Investment	135.3
Net Exports	3.6
Total	$974.1

With 1970 as the departure point and based on 1970 prices, a "best" prospect projection for 1980 reveals a GNP of $1,529 billion (Table 1, Appendix, furnishes annual estimates). This estimate is drawn from the following key assumptions:

- a 1980 population of 228,000,000 derived from an annual growth rate of 1.0 percent,
- an unemployment rate of 3.8 percent,
- a personal consumption growth rate of 4.7 percent annually,

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1. This is not the same as total government budgets or total outlays, which, in addition, include transfer payments for social security, interest on debts, pensions, etc.

- a gross domestic private investment growth rate of 5 percent annually,
- a government expenditure growth rate of 6.9 percent annually, and
- exports regaining a positive trade balance by 1973 and continuing thereafter.

The left side of Figure 2 portrays 1980 GNP against the 1970 reference point and indicates the changes projected for each of the four components. As noted, the rise through the decade is $557 billion in the aggregate, reflecting an overall growth rate of 4.3 percent annually (1970 prices). Personal consumption and gross domestic private investment carry the largest shares of the increase. To provide some sense of proportion and perspective, two other projections are given on the right side of Figure 1, depicting a high and a low GNP projection.

Briefly, a few points are noteworthy about each of the projections and their components.

PERSONAL CONSUMPTION

Personal consumption expenditures are the largest component of GNP, annually comprising about two-thirds of the total. For any level of GNP, personal consumption expenditures will grow at a higher rate than its associated GNP. The personal consumption sector of personal consumption expenditures are expected to continue the rapid growth begun in the 1960's. Several factors will contribute to this growth: a further accumulation of consumer durables, increases in personal incomes, increased demand for services, and increases in leisure time expenditures for recreation and travel. Consumer durables are expected to maintain a higher rate of increase because of new family formation resulting from the high birth rates immediately after World War II.

Best Prospect--Personal Consumption Rising to $999 Billion in 1980, up from $616 Billion

The best prospect projection assumes an annual growth rate of 4.7 percent for personal consumption expenditures, with unemployment averaging 3.8 percent,

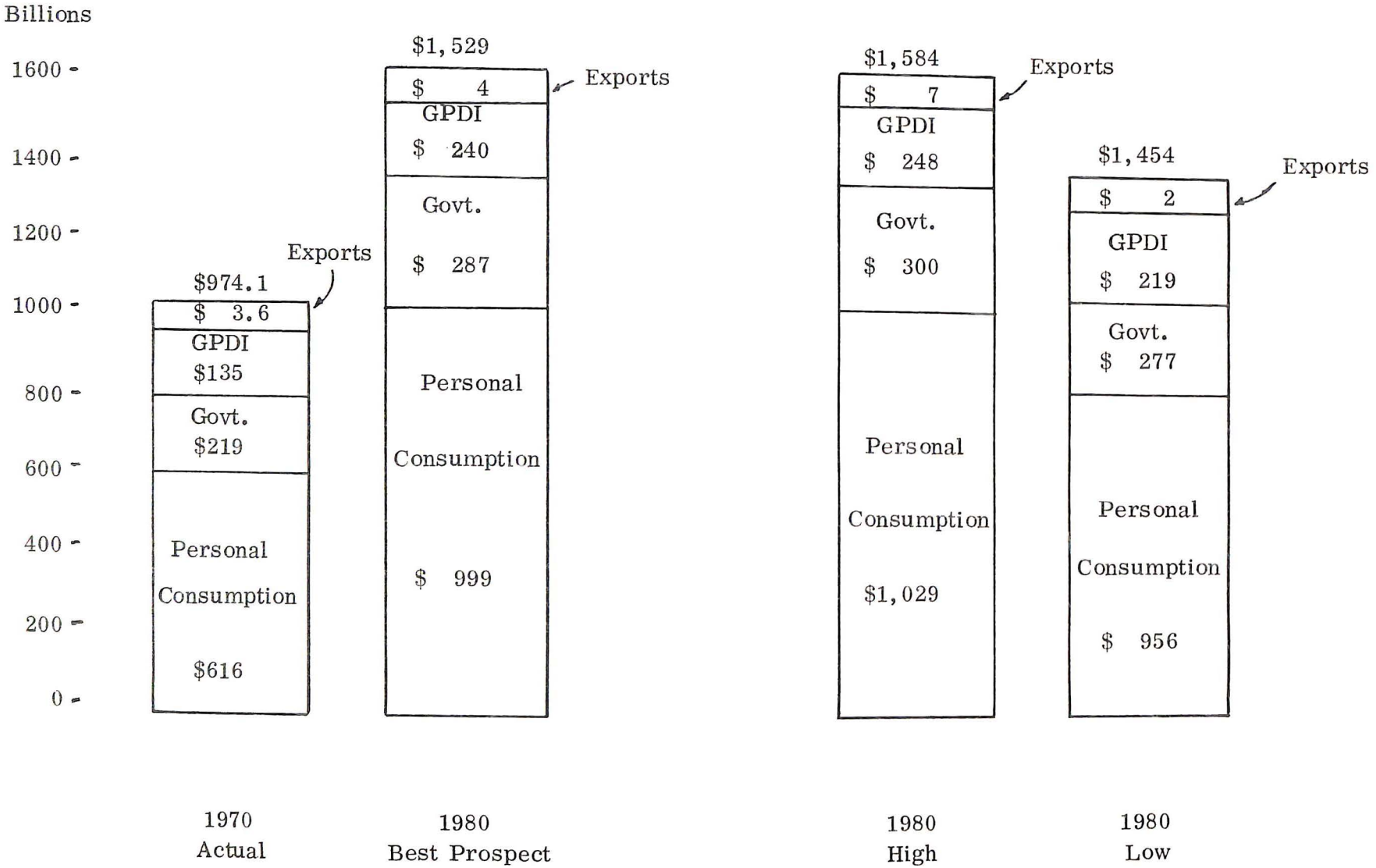

Figure 1: GROSS NATIONAL PRODUCT

and a steady decrease in poverty. The personal consumption of services is projected to increase at an annual rate of 6.25 percent. (Table 2, Appendix, contains the annual levels for each of the projections.)

High--Personal Consumption Reaches $1,029 Billion by 1980

The high projection assumes continuous GNP growth and a growth of 5.1 percent per year for personal consumption expenditures with unemployment in the range of 3.5 percent and a marked decrease in poverty. Personal consumption is projected at an annual rate of 5.65 percent.

Low--Personal Consumption Rising to $956 Billion in 1980

The low projection assumes that the growth rate is not continuous and will average only 4.2 percent per year for personal consumption expenditures. Unemployment will average around 4.0 percent and there will be no decrease in poverty. Personal consumption in the services sector is projected at an annual rate of 4.75 percent.

GROSS PRIVATE DOMESTIC INVESTMENT

Gross private domestic investment (GPDI) is the capital formation of an economy. It has a direct and measurable effect on GNP. Of the several components of GPDI, purchases of producers' durables are of primary interest to the aerospace industry because commercial aircraft are classified as producers' durables.

Best Prospect--GPDI Reaches $240 Billion in 1980 from $135 Billion in 1970

The best prospect projection assumes a middle point between the high and low projections. This mid-point is achieved primarily from modernization of plant and equipment and an effort to close the housing gap. From these assumptions, GPDI is projected to grow at 5 percent per year from 1972 to 1974 and at 5.5 percent per year from 1975 to 1980. Producers' durables are projected to grow at 5.5 percent per year from 1972 to 1974 and at 6 percent per year from 1975 to 1980. (Table 3, Appendix, presents the details.)

High Projection--GPDI at $248 Billion in 1980

The high projection assumes that, while currently there is excess plant and equipment capacity, consumers' demand will remain strong during the decade and new capacity will be added. Coupled with this is an accelerated modernization of existing plant and equipment capacity to achieve a better competitive position in both domestic and foreign markets. The demand for new residential housing remains strong because of chronic insufficiency since World War II, and an accelerated effort such as in modules is expected to close this housing shortage--especially in low and moderate priced structures. Using these assumptions, GPDI is projected to grow at 5 percent per year from 1972 to 1974 and at 6 percent per year from 1975 to 1980. Producers' durables were projected to grow at 5.5 percent per year from 1972 to 1974 and 6.5 percent per year from 1975 to 1980.

Low Projection--GPDI Rising to $219 Billion in 1980

The low projection assumes that the addition of new capacity is minimal and modernization of existing plant and equipment capacity is on an as-needed basis. Demand for new residential housing is strongest because of new family formation, but there is no accelerated effort to close the housing gap. From these assumptions GPDI is projected to grow at 4 percent per year from 1972 to 1974 and at 4.5 percent per year from 1975 to 1980. Producers' durables were projected to grow at 4.5 percent per year from 1972 to 1974 and at 5 percent per year from 1975 to 1980.

GOVERNMENT PURCHASES

Government purchases of goods and services include transactions made by government at all levels--local, state, and federal. Governmental expenditures for Social Security, Medicare, subsidies, welfare payments, and interest on the national debt are transfer payments and are not included. Purchases of goods and services by the Federal Government are of special interest, as this is the source of funds for government procurement of aerospace products.

The size and growth of the government sector of GNP depends upon: funding levels for current programs, new or backlogged programs, and the role government will take with respect to stabilizing and promoting growth of the economy. Total Federal Government purchases of goods and services are not expected to grow at the rates experienced in the 1960's; however, state and local purchases will grow at a higher rate than in the past.

Some shifting of expenditures can be expected. Declines in the birth rate should reduce the share of state and local expenditures going to education. In the decade of the 1960's, defense expenditures declined as a percent of the total federal purchase of goods and services from 89 percent in 1960 to 79 percent in 1969, a trend resulting from high rates of growth for the purchase of goods and services for civil functions of the Federal Government and not from an absolute decline in defense funds.

Best Projection--Total Government Expenditures on Goods and Services at $287 Billion in 1980, up from $219 Billion in 1970

The best prospect projection assumes the Federal Government will not undertake any programs that will require increases in expenditures, as in the low projection, but will increase grants-in-aid to state and local governments, as in the high projection. Federal expenditures are projected to increase 1.25 percent per year to $112 billion in 1980; state and local expenditures will increase 2.1 percent per year along with the $5 to $10 billion increase in grants-in-aid. (Table 4, Appendix, presents the annual estimates.)

High Projection--Total Government Goods and Services Expenditures reach $300 Billion in 1980

The high projection assumes that the Federal Government will increase expenditures throughout the decade in order to undertake and operate civil programs of high national need and will provide state and local governments with additional funds either as specific grants-in-aid, block grants, or as revenue sharing. Federal expenditures for goods and services are projected to grow at

an annaul rate of 2.5 percent, reaching $125 billion in 1980. State and local grants will increase to $5 billion by 1973, increasing to $7 billion in 1976, and to $10 billion for the latter years of the decade. State and local purchases are projected to increase to 2.1 percent per year without the federal grant increase.

Low Projection--Total Government Goods and Services Expenditures at $277 Billion in 1980

The low projection assumes that the Federal Government will not undertake any programs that will require increases in expenditures and will not increase grants-in-aid to state and local governments. Any new programs will have to be funded from existing programs. Federal expenditures are projected to increase 1.25 percent per year or about $11 billion for the decade. As in the high projection, state and local expenditures are projected to increase at 2.1 percent per year.

NET EXPORTS OF GOODS AND SERVICES

For the first time in this century, U.S. net exports of goods and services had a negative balance in the second quarter of 1971. To stimulate exports, the U.S. on August 15 let the dollar float by no longer exchanging gold for dollars and prices and wages were frozen. To curtail imports, a 10 percent surcharge was leveled on the F.O.B. wholesale price of most imports. Five variables will determine the future for net exports of goods and services:

- effect of the surcharge,
- amount of retaliation against U.S. exports by foreign governments,
- ability of the United States to remain a leader in technology,
- rate that industry modernizes its productive assets, and
- rate at which worker productivity increases.

These five variables are somewhat mutually exclusive and, therefore, many different combinations are possible. In making the projections, it has been assumed that all five will react similarly. Thus, for example, the combination of trade retaliation and a high rate of productivity are not considered.

Three projections of net exports of goods and services have been made. The difference between projections depend upon how well each of the above five variables perform. It should also be remembered that net exports is a net account and is less independent of past experience than are the other components.

Best Prospect--Net Exports at $4 Billion in 1980, about the same as 1970

The best prospect projection assumes that the surcharge is effective and that foreign governments do not retaliate against U.S. exports. It assumes modest increases in technology, plant and equipment modernization, and productivity. From these assumptions the U.S. regains a positive balance of $1 billion in 1973 and increases this balance to $4 billion in 1980.

These projections are shown in Table 5, Appendix.

High Projection--Net Exports Reach $7 Billion by 1980

The high projection assumes that the surcharge is effective, that foreign governments do not retaliate against U.S. exports, that U.S. technology grows faster than other industrial nations, that plant and equipment modernization is accelerated, and that productivity increases 5 to 6 percent per year. From these assumptions the U.S. regains a positive balance of $3.3 billion in 1973 and increases this balance to $7.1 billion in 1980.

Low Projection--Net Exports Drop to $2.6 Billion in 1980

The low projection assumes that the surcharge is not effective, that foreign governments retaliate against U.S. exports, that U.S. technology lags and other industrial nations make inroads, that the major part of investment is for modernization and replacement of plant and equipment assets, and that productivity increases are zero or minimal. From these assumptions, the U.S. will just break even in 1974 and in 1980 will have a $2 billion positive balance.

PERSPECTIVE

The American economy is currently experiencing a new combination of two familiar conditions--a high rate of inflation coupled with a high rate of unemployment, the two "discomfort" forces at work in the economy. In the past, the directions of change in these conditions were roughly the opposite. The traditional fiscal and monetary policies have not been sufficient to remedy these stubborn conditions, and combating inflation with increases in taxes and interest rates and reduced government expenditures has led to a rising unemployment. Stimulation of the economy to reduce unemployment can set off a new round of inflation.

At the time the projections of the U.S. economy were being formulated, the President announced a "new economic policy" that had both domestic and international implications. The major points of this policy are:

- a 90-day freeze on prices, rents, and wages;
- a consumer sales tax reduction that repeals the 7 percent excise tax on automobiles retroactive to August 12, 1971, and a $50 increase in the federal personal income tax exemption to take effect on January 1, 1972;
- a 10 percent tax credit on new industrial investment for one year and 5 percent thereafter;
- a reduction in Federal Government expenditures and employment;
- discontinuance by the U.S. Government of converting foreign-held dollars into gold; and
- a 10 percent surcharge on the F.O.B. wholesale price of most imports.

As of the date of this report, it is too early to assess the effects of this package, but it will likely require more than the time estimated by the Administration to stop inflation.

Turning to the international implications, the floating of the dollar has thus far only achieved partial equilibrium. Together with the 10 percent surcharge on imports, an equilibrium of sorts has been accomplished. But the surcharge cannot be a permanent mechanism and formal action concerning the U.S. dollar

must soon be taken. One proposed formula is that the U. S. devalue by half the amount required for stability and the major free-world industrial states revalue their currencies upward to account for the other half. Current thinking places the logical decline of the dollar to be between 12 and 15 percent.

All indicators point to 1972 as the year of transition. The domestic economy should begin to grow again, the dollar should find equilibrium in the international market place, and the United States' participation in the war in Southeast Asia will be minimal.

Taking these factors together, it seems clear that the 1970's will be far different from the 1960's with regard to American social, political, and economic goals. Growth, once considered as a major goal and as a necessary condition for economic survival, has been reappraised. The birth rate has decreased and this trend is projected to continue throughout the decade. For many Americans, the accumulation of economic wealth has become less important than economic sufficiency, leisure, and improving the quality of life. International relations show signs of marked change. Domestic problems--economic, social, and institutional--are and will be the issues of the 1970's.

3

PROJECTIONS OF THE DEMAND FOR AEROSPACE PRODUCTS

In this section, demand for conventional aerospace products is projected. Included are defense and space expenditures by the U.S. Government and the demand by the private sector for commercial air transports, all-cargo aircraft, general aviation products, and aircraft repair parts.

DEFENSE EXPENDITURES

Forecasting the level of future defense expenditures is a complex and inexact process because the basis of good defense planning is an assessment of the threat and it is here that disagreement usually begins, and different threat assumptions carry right through missions and roles, the size and mix of forces, and the type of quantity of weapon systems.

Since there are no exact answers to any of these questions, the choice since the Korean War has been one of not taking unnecessary chances on matters of national security. After almost two decades of use, this policy has now been opened to question by both the executive and legislative branches of governments as well as by private citizens.

The war in Southeast Asia has accelerated and joined the issue. Ancillary is the reduction of U.S.-U.S.S.R. tensions exemplified by the Strategic Arms Limitations Talks (SALT), and the agreement between West and East Germany on Berlin, as well as the agreement between West Germany and the U.S.S.R. on the

East German border. Diplomatic contacts have also been made with the Peoples Republic of China with a planned presidential visit to Peking.

Finally, the so-called Nixon Doctrine holds that the U.S. will supply materiel and money to foreign governments for their self-protection, but these governments will supply the fighting troops.

The general effect of these factors seems to give a profile of defense expenditures for the 1970's that will differ from those of the 1960's. Foremost, defense expenditures will become a smaller percentage of GNP than they were in the past decade, running probably around the 6 percent level, as contrasted with 9 percent during the late sixties. An upper limit of 2.5 million men in the armed forces has been stated by the Secretary of Defense.

With constrained levels of funding and a reduction in military personnel, defense planners are faced with some difficult choices. Inflation of the past few years has depreciated what the military dollar can purchase. In the last six years, there have been eight pay raises and more are projected for the future, particularly if an all voluntary force is enacted. With military personnel becoming more expensive, it is inevitable that more efficient use of personnel resources will have to be made.

As force levels are reduced, the military overhead--primarily operations and maintenance funds--can be expected to decrease, although some time will be required to make this adjustment. A more difficult choice involves further reductions in military personnel strength to free funds for procurement of weapons and materiel.

The effects of inflation and increasing costs have also had a large impact on defense dollars. With smaller rather than larger defense expenditures, the choice will become either fewer weapon systems or smaller quantity purchases.

Weaving these different threads together to form a strong and attractive fabric is not easy. The method of deriving defense expenditure projections involves joining three principal factors: military personnel and associated outlays, R&D expenditures, and materiel procurement. Starting with an assumed force level,

operations and maintenance costs are expressed as a generally constant fraction of personnel pay and benefits costs. To these are added outlays for military construction and family housing. RDT&E outlays are assumed to remain at a constant or modestly increasing level. The remaining element, procurement or materiel, is then derived as a residual or difference between the sum of the foregoing and a total defense outlay calculated as 75 percent of the projected Federal Government expenditures for total goods and services. (The 75 percent factor is the expected share based on recently observed trends.) For example, with an assumed federal outlay of $100 billion for goods and services, $75 billion would be assigned to defense purchases. If personnel, O&M, construction, and housing totalled $50 billion and RDT&E was $8 billion, this would leave $17 billion for procurement.

Using this general method, projections were developed for each category of defense expenditure through the remainder of the decade. As earlier, three forecasts were prepared. (Table 6, Appendix, sets out the relevant details.)

Best Prospect--Total Defense Outlays Reach $81 Billion in 1980, Up from $75 Billion in 1970

The best prospect projection assumes a military personnel strength of 2.3 million men and women. Procurement expenditures are projected to decrease at a very slow rate over the decade, but never fall below $18 billion annually. For this estimate, 1972 and 1973 are years of adjustment, and defense expenditures are projected to decrease to a low in 1974 and then increase slowly for the remainder of the decade. Research and development projection is the same as for the high projection.

High Projection--Defense Outlays Rising to $91 Billion in 1980

The high projection assumes a military personnel strength of 2.5 million men and women and procurement funding is kept above $20 billion per year for the decade. Under these assumptions, aircraft, missile, and ship procurement are projected

at an almost constant level for the decade. Research and development expenditures will increase to advance military technology. There will also be more prototyping with the result of larger leadtimes for new weapon systems. Total expenditures will continue to increase over the decade primarily due to annual increases in personnel and operating and maintenance costs.

Low Projection--Defense Outlays Drop to $70 Billion from Current Level

The low projection assumes a military personnel strength of 2.0 million. Total defense expenditures were assumed to decrease until 1975 and then begin to rise slowly. Under these assumptions, procurement expenditures decrease each year and research and development expenditures are projected to remain constant.

As can be seen from Table 6, differences between alternatives are relatively small, as the projections address the current world situation and current policies. The projections do not incorporate any changes on the high side that might be expected if a major new world crisis should develop, nor a set of policies and forces on the low side that would represent isolation from world affairs.

Projections of military procurement do not, of themselves, delineate the aerospace defense market; since they contain total outlays, they represent rifles as well as aircraft. It is, therefore, necessary to make one further calculation to arrive at the aerospace portion of the defense expenditures. This involves simply adding the estimated aircraft and missiles procurement estimates to that fraction of RDT&E ascribed to aircraft and missile R&D. The historical experience through the sixties has been that aircraft and missiles R&D has carried about half the total RDT&E budgets, although from budget to budget there was inevitable variation. For broad estimating purposes, the aircraft and missile portion of RDT&E was set at 4.5 billion for the best prospect projection through the decade after observed levels of $4.4 and $4.3 billion, respectively, for 1970 and 1971. For the high projection, this R&D level was increased slightly, and for the low projection given a slight decrease. Obviously, there are no formulas to set these particular levels and they simply represent reasonable judgments.

The detailed annual projections of aerospace industry sales to Department of Defense based on these assumptions are given in Table 7, Appendix. They reveal a best prospect of $14 billion in 1980, or just about the same level as DOD sales in 1970. The high estimate indicates a $17 billion level at the end of the decade, while the low projection shows a drop to just over $10 billion.

PROJECTED SPACE (NASA) EXPENDITURES

In order to project the most reasonable range of federal allocations for the NASA budget, particular assumptions must be stated on which to rationalize estimates. With the completion of a successful Apollo program due in 1973, expenditures have already been made to initiate the Skylab and Space Shuttle programs. However, total NASA funding has steadily decreased from year to year since the peak in 1966, and both 1971 and 1972 appear to be years of minimal expenditures of about $3.3 billion annually.

Best Prospect--A Moderate and Balanced Space Program of $3.2 Billion for Aerospace

Because of other federal program priorities and limited resources from tax revenues, it is assumed that total NASA funding will be minimized until 1975. Growth in each program will be strictly rationalized and the Space Shuttle will provide some economies in the costs of space stations. Hence, manned space flight activity increases in the last half of the decade, accompanied by an increase in space science and applications expenditures, and some construction of facilities, while interplanetary projects continue.

The time stream of expenditures can have several variations as the various stages of the integrated space transportation system progress. One stream consistent with the foregoing assumptions is a constant level of NASA expenditures until after the Skylab testing phase is completed. A gradual increase of about 4 percent annually in NASA funding is then projected from 1975 to 1980, including enough funds to develop and perfect the Space Shuttle so that it will be instrumental in constructing an orbital space station.

Meanwhile, the Interplanetary Grand Tour program is expected to start slowly in 1972, with expenditures increasing more rapidly after 1975. The production and orbiting of earth resources, weather, and communications satellites will be maintained at a fairly constant rate for applied space technology. The results of projecting this pattern of expenditures annually appear in Table 8, Appendix.

High Projection--An Expansive Program of $3.5 Billion for Aerospace by 1980

This alternative assumes all programs will proceed approximately at the rate that NASA would specify. Therefore, construction of additional facilities will be needed by the middle of the decade. The Space Shuttle will progress at a rate that will achieve targets proposed. Interplanetary probes and orbit projects will be endorsed as specified; basic research will proceed provided that applications are justified both technically and economically. Manned space flight activity associated with the shuttle and space stations will accelerate after 1974, along with an increase in space science applications. Nuclear rocket motor technology will advance toward the application stage in the 1980's. The Grand Tour program and applied space technology will proceed as expected.

These activities describe an expansive space program that is nonetheless feasible for the decade. Significant achievements in space by the USSR will perhaps make this program even more feasible. Congress will at least have to endorse program budgets at approximately the requested levels, if not give high priority to space efforts.

The expenditure pattern implied by the expansive program is one in which the budget increases sharply during and after 1974 and reaches a plateau much higher than before 1975.

Low Projection--A Constrained Space Program of $2.5 Billion in 1980

From the current level, a minimal zero-growth trend of NASA funding can be projected for the decade, if it is reasonable to assume stringent economies on expendable and reuseable space hardware, making the most of currently available apparatus and facilities, and limiting program targets. Limited unmanned automated programs would be emphasized. Skylab and the Space Shuttle would be restricted in scope and target dates.

Along with the foregoing policy, there is the additional assumption that heavy demands of social programs will claim most of the increase in federal revenues and it is also assumed that U.S.S.R.'s space achievements will not move rapidly ahead of the U.S.

Validity of these assumptions and policies could result in the flattening out of space expenditures at an annual average level that is equal to the current activity. The result is $3.3 billion per year in NASA allocations, with roughly constant expenditures in each program area corresponding to current proportions, except for a slight gain in space science applications, chiefly at the expense of manned space flights.

COMMERCIAL AIR TRANSPORT

The commercial air transport market has begun to slump in the past couple of years resulting from the economic downturn affecting the airline industry. In the past decade, air carriers had gone through a very strong period of growth in air travel and with the advent of the new wide-bodied jet aircraft, they ordered additional planes on the assumption that this growth would continue. With the general economic slump, air travel growth virtually ceased and the airlines were faced with aircraft delivered and the resultant capacity and expense increased with no new revenue sources. Some carriers not only canceled aircraft options but in some cases even their firm orders.

In addition to the lagging air passenger market, the airlines are facing increased competition domestically over prime routes as the Civil Aeronautics Board has awarded many new route certificates. The number of foreign airlines serving international routes has also increased. The combination of increased capacity and completion has led to rate and fare competition that has greatly reduced unit traffic yield in the face of increasing unit costs.

A further limitation of the aerospace industry's commercial transport market is the lack of any imminent technology change that will stimulate the air travel market and, hence, aircraft sales. The vehicles presently being produced have reached a size and speed capability that will meet the air carriers' requirements for the next several years. Speed is just below the sound barrier, and the U.S. supersonic transport program has been greatly delayed if not destroyed. Present aircraft will carry up to 350 people and terminal facilities and services are experiencing difficulty in handling groups this size, let alone larger groups.

For this forecast, some general predictions of the general fleet environment of the airlines and the resultant aircraft production mix were made. By 1975, production of first-generation jet transports was assumed to be concluded. Replacements and additional capacity will be wide-body aircraft of two-, three-, and four-engine configurations. The Anglo-French supersonic Concorde is scheduled to begin passenger service in 1974. The wide-body and supersonic aircraft types will together involve the major production of the decade. In addition to the remaining production of first-generation jet transports, there will be a demand over the decade for some small feeder type aircraft and towards the end of the decade for some STOL aircraft.

The best prospect forecast is based on a general economic upturn with a 10 percent increase in demand through 1976 and 8 percent per year thereafter through 1980. On the basis of only moderate growth of the economy, this best prospect estimate is for a demand of about 1,260 billion seat-miles in 1980. Year-by-year growth patterns for the three forecasts are shown in Tables 9 through 11, Appendix.

The high forecast assumes a rapid recovery of both the economy and the airline business, plus promotional fares that will be instituted to utilize the excess capacity and attract new passengers. Both this and the next (medium) forecast show a higher growth rate through 1976 than for subsequent years in the decade. One reason for this is the increasing yearly demand that is difficult to maintain as the base grows. Also, most untapped air travel markets will be exploited by 1976, and further growth will be related more to population growth and makeup as well as general economic conditions. The high growth rate based on these assumptions is estimated at 12 percent per year through 1976 with a 10 percent increase annually for the rest of the decade. This method gives a forecast of a 1,483.7 billion seat-mile requirement in 1980. Because of evidence that 1971 traffic growth will be less than 12 percent, a growth rate of only 10 percent is used for that year.

The low forecast is based on a recovery from the present slump (or lack of growth) but a rather reduced growth rate of only 8 percent per year for the entire next decade. This results in a total free world (total world less U.S.S.R. and allied nations and the Peoples' Republic of China) seat-mile demand of 1,128.5 billion in 1980.

To compute commercial aircraft purchases during the decade, the rate of aircraft retirement was an additive factor to air passenger travel growth. Most airlines depreciate present aircraft over about 14 years although there is evidence that they last longer than that. However, some are sold or destroyed prior to being written off the books, so the 14-year (7 percent per year) period was used. Recent history and the traffic growth figures show this to be about the equivalent of 2 percent of the current seat-mile demand. In the 1980 "most likely" forecast estimate of 1259.8 billion seat-miles, the new demand over 1979 is 166.6 billion seat-miles. This is composed of an 8 percent demand growth (93.3 billion seat-miles) and a retirement of 23.3 billion seat miles. The latter is 2 percent of the 1979 forecast seat-mile demand and is approximately 7 percent of the seat-mile capacity in 1966. Considering the 14-year depreciated life of commercial

aircraft, the latter factor tends to verify the retirement percentage used in the forecast. In all three of the forecast tables, the annual new seat-mile demand is shown year by year for the 1971-1980 decade.

In order to convert worldwide seat-mile demand into total aircraft purchases, a cost factor was developed that represented the aircraft purchase cost per seat-mile of demand for the mix of aircraft that were predicted to be in the world airline fleets during the various forecast years. This turned out to be approximately 5 cents per annual seat-mile of capacity in the latter part of the decade, up from about 4 cents in the earlier years. Total new aircraft demand increases quite steadily during the decade to a high of $6.191 million in 1980.

The next step involved separating the total demand into sales of U.S. and foreign manufactured aircraft. A number of assumptions were made to achieve this:

(1) For each forecast year, the capacity demand was allocated evenly between U.S. and foreign air carriers.

(2) U.S. airlines will purchase virtually all conventional jet aircraft from U.S. manufacturers while foreign carriers will buy 60 percent of their requirements from the U.S. and 40 percent abroad. Thus, U.S. manufacturers will achieve 80 percent of the world's conventional jet aircraft sales.

(3) Between 1974 and 1980, supersonic transport sales will be 12 percent of each year's projected aircraft purchases. These will all be sales of the British-French Concorde, the demand for which will be split evenly between U.S. and foreign carriers.

Using these figures, the total seat-mile demand between 1974 and 1980 will be split into the following segments:

Demand for U.S. manufactured jet aircraft (44 percent by U.S. carriers and 26.4 percent by foreign airlines)	70.4 percent
Demand for foreign manufactured jet aircraft (60 percent of foreign carriers' jet capacity that will be 44 percent of the total)	17.6 percent
Demand for Concorde	12.0 percent
	100.0 percent

The total best estimate of demand in billions of dollars for U.S. manufactured passenger aircraft will reach $4.358 billion in 1980. The trend seems realistic in terms of present status of the airlines and aircraft manufacturers. In 1971 there is a slight drop from 1970 sales that continues to 1974, when a slow recovery begins. But the 1970 sales level will not be achieved again until the late 1970's. With all of the new capacity that is already in operation and on order, the orders will be limited until the market catches up with this capacity. (See Table 9, Appendix.)

Of this total demand of $4.358 billion in 1980, $1.634 billion will be for export sales to foreign airlines. This is higher than for any other year during the decade. The domestic sales portion by comparison will be $2.724 billion. In addition, Concorde sales in U.S. of about $743 million are predicted plus $1,090 million in sales of foreign manufactured conventional jet aircraft.

The unusually heavy delivery of U.S. aircraft to foreign buyers in 1971 is expected to be followed by a severe drop and only a gradual return through the rest of the decade. Exports are not likely to reach the 1971 peak, however.

COMMERCIAL ALL-CARGO AIRCRAFT

Because of the large and rapid growth of air passenger traffic in the past decade, the cargo portion of air transportation suffered through neglect. However, in the very recent years the airlines have been actively pursuing this business with the result that the growth of air cargo has been at a higher level than in air passengers. Jet all-cargo aircraft have been introduced into service and automated terminals constructed. Containerization is common on all-cargo aircraft as well as in the cargo compartments on passenger aircraft.

Although the rapid growth of air cargo traffic will continue into the coming decade, it will not be correspondingly reflected in the growth in sales of all-cargo aircraft, particularly until 1975. Two factors are the primary reason. The first is the cargo capacity of the new wide-bodied jet passenger aircraft. The Boeing 747, for example, can carry up to 50,000 pounds of cargo after accommodating all passenger baggage. This compares to the 75,000 to 90,000 pound capacity of current all-cargo jet aircraft. Although the B-747 is offered in an

all-cargo configuration, only one has been ordered so far and there is little reason to believe that more than an isolated order here and there will be realized for the next 3 or 4 years.

The second factor that will inhibit the growth of all-cargo aircraft sales is the excess capacity in current convertible jet aircraft that can be operated in either an all-cargo or passenger configuration. As wide-bodied jets (Boeing 747, Douglas DC-10, and Lockheed L-1011) are delivered in the next few years, some of the smaller jets will become surplus and will be downgraded to an all-cargo configuration. These aircraft plus the cargo capacity of the new larger passenger aircraft will absorb most of the air cargo growth to 1975.

Beginning in 1975, however, the airlines will have to begin to add new all-cargo capacity. This will be to absorb growth and to replace early conventional jet all-cargo aircraft that will begin to be fully depreciated and also more costly to operate than the newer and larger all-cargo aircraft that will begin to be fully depreciated and also more costly to operate than the newer and larger all-cargo aircraft that will then be available. The most likely forecast of the extent of new purchases of all-cargo aircraft begins at $80 million in 1975 and increases to $800 million in 1980. The low forecasts for these sales ranges from $60 to $700 million per year during that same period. A high estimate ranges from $100 million in 1975 to $950 million in 1980. Approximately 40 percent of all these sales forecasts will be to foreign air carriers. The year-by-year low, high, and best prospect forecasts for this period are as shown in Table 12.

Table 12

ALL-CARGO AIRCRAFT SALES FORECAST
(millions of 1970 dollars)

Year	Best Prospect	High	Low
1975	80	100	60
1976	150	175	120
1977	250	300	220
1978	400	500	340
1979	600	725	525
1980	800	950	700

No significant sales are predicted until 1975 for the reasons outlined earlier. Also, the sales data above are not related to any air cargo volume forecasts as were the sales of passenger aircraft due to the complexity of predicting the number of convertible aircraft that will be downgraded to cargo service and the extent to which the airlines will be able to attract cargo to move on the scheduled passenger flights.

GENERAL AVIATION AIRCRAFT

Demand for general aviation aircraft is extremely sensitive to economic conditions. For example, the number of such aircraft shipped by selected manufacturers dropped from 12,456 in 1969 to only 7,283 in 1970, a year of general economic recession.[1] Traditionally, sales of these products decline ahead of many other signals of reduced economic activity and also lag behind in periods of economic recovery. Because most of these aircraft are purchased and operated with personal disposable income (after tax), this is a luxury that can be foregone early. The increased level of gasoline taxation recently instituted by the Federal Government on these operators may be a further retardant to growth of this segment of the aerospace industry's market.

For these reasons, the demand for general aviation products is projected to grow only gradually to $600 million in 1972 from a low of about $425 million in 1970. The rate of growth will recover to a dollar level of $200 million per year through 1975 to a total of $1.2 billion. The growth is then forecast to slow down, from 1976 through 1980, averaging $100 million per year. Total sales reach a high of $1.6 billion in 1980, which is over twice the level of any of the peak sales years prior to 1970.

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1. Aerospace Industry Association of America, Inc., 1971/72 Aerospace Facts and Figures, Aviation Week and Space Technology (New York, 1971), p. 37.

In addition to this best prospect estimate of general aviation aircraft demand, a high and low forecast were made. As shown in Table 13, Appendix, the former reaches a high of $1.9 billion in 1980 while the low forecast predicts $1.0 billion in sales that year. The latter presumes that economic activity will recover at a slow rate from the present level while the high forecast is based on a rapid recovery and a return to the economic progress level of the 1960's.

AIRCRAFT PARTS, ACCESSORIES, AND EQUIPMENT

In addition to complete aircraft sales to the commercial and general aviation market, the aerospace industry also supplies parts, accessories, and equipment for initial inventory to support these aircraft and thereafter upon demand as maintenance and replacement require. Some general rules have emerged over the years as to purchase level for the initial order for spares--25 percent of initial engine purchase and 10 percent equivalent parts for airframes. These plus the routine orders totalled about $1.3 billion in 1970.

After a slight drop in 1971 reflecting the severely reduced domestic aircraft deliveries, the best prospect forecast assures increases of $100 million per year for the decade. (See Table 14, Appendix.) The best 1980 forecast of the complete parts, accessories, and equipment market under these assumptions will be $2.1 billion with $1.1 billion to domestic buyers and $1.0 billion for exports. A low estimate based on a slow air and cargo market growth as well as a slow increase in general aircraft sales results in a 1980 market total of $1.7 billion. Conversely, a rapid recovery from the present aircraft market slump and a corresponding rapid market growth will lead to sales of $2.9 billion in 1980.

NON-AEROSPACE PRODUCTS

Although the aerospace industry's efforts to diversify and expand into markets outside the conventional demand periphery have not been of major dimensions, neither have they been trivial. In fact, during the past five years the sales of

non-aerospace products by aerospace firms have run at a fairly constant $2 billion, or about 10 to 11 percent of the total of defense, space, commercial aircraft, general aviation, and repair parts and accessories sales. There is, of course, no final way to prove that this factor is a stable or long-enduring relationship to the particular sales components. It does, however, provide a benchmark for estimating the non-aerospace market, assuming no major changes in prevailing policy or general economic conditions.

The 10 percent factor was used to calculate the figures for the best prospect and low projections. The key assumption was that the proportion would not shift or accelerate, although the absolute amount would reflect growth in conventional product sales. For the high projection, it was assumed somewhat arbitrarily that the ratio of non-aerospace to conventional product sales would increase through the decade, running at 12 percent in 1975 and 15 percent thereafter to 1980. This acceleration in the share was intended to reflect the condition that more national and industry growth would provide greater opportunities for diversification and penetration into these market areas beyond the conventional product lines. The consequence of these assumptions and proportions are to give a best prospects sales level for non-aerospace items of $2.6 billion by 1980. The high projection reaches nearly $5 billion and the low comes to $2 billion by the end of the decade.

RECAPITULATION: DEMAND FOR AEROSPACE PRODUCTS

On the basis of the foregoing assumptions and analyses, it is useful to consolidate the estimates and projections reached so far. Figure 2 (which is based on the more detailed Table 15, Appendix) brings together each of the demand categories and their projections under the best prospect, high, and low assumptions. The principal features of all three projections is the continuing importance that defense and space carry and the moderate growth prospects present in the commercial and cargo aircraft and parts and accessories categories. Most evidence suggests that defense and space will hold to their current general levels

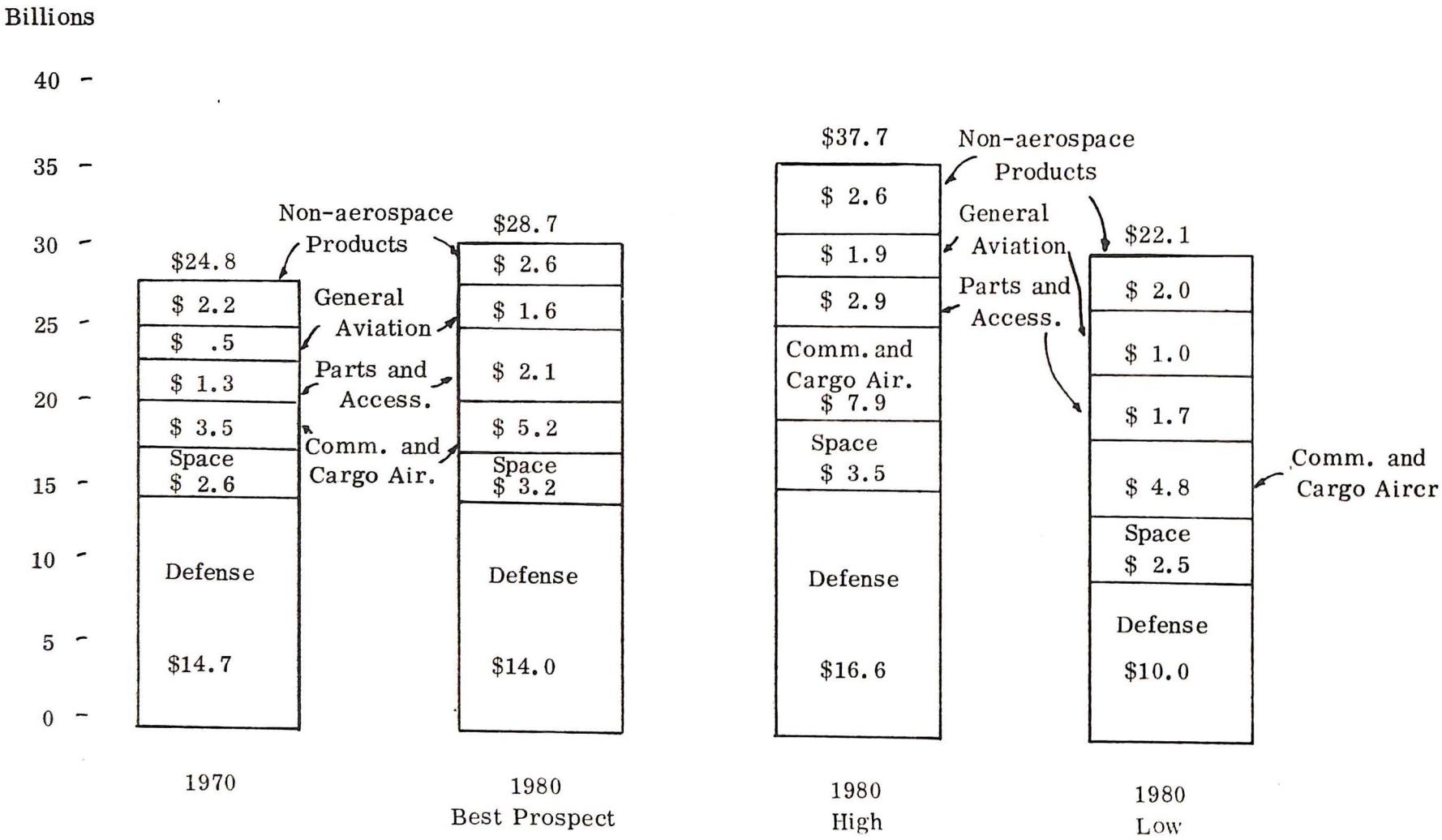

Figure 2: AEROSPACE SALES

through the decade, but will take slightly declining proportions of the total market, dropping from roughly 68 percent in 1970 to somewhere between 54 and 48 percent in 1980. Conversely, the commercial and cargo aircraft and parts and accessories segment is projected to rise from its current 20 percent share to something between 36 and 34 percent in 1980.

4

AEROSPACE NON-MILITARY EXPORTS

In the preceding discussions of projected sales of aerospace products, the non-military foreign demand portions of total civilian sales were identified. It may be helpful here to consider briefly the overall nature and implications of aerospace exports. In the past aerospace exports have been a major factor in supporting positive trade balances. Since 1968 the industry's exports have averaged annually about 8 percent of total U. S. exports and accounted for between 100 to 200 percent of the nation's annual trade balance. Of the total aerospace exports, military aerospace sales have run annually to something between one-third and one-fourth of the total export values.

Three projections for exports of non-military aerospace exports are given in Table 16, Appendix. This summarizes in one place most of the estimates and projections developed for each of the particular product categories. The most striking point of all three projections is the peak that 1971 is likely to represent as respects aerospace exports. From that point, however, the demand-derived estimates indicate a drop in export sales through the middle years of the decade. After 1973, (1974 in the low projection) sales abroad begin to rise as the cargo aircraft begin to enter the market.

Overall, the forecast of best prospect conditions for aerospace exports suggests that aerospace will sustain its recently achieved relationship to total exports and the Gross National Product. Through the latter part of the sixties, gross U.S. exports have run to about 4 percent of annual GNP. Using this factor for the best

prospect GNP, in 1975 total exports would be approximately $50 billion, of which best prospect aerospace are estimated at $2.3 billion, or 5 percent. By 1980, total U.S. exports are projected to be about $61 billion, with aerospace exports estimated at $3.5 billion, or approximately 6 percent. These conclusions are based, of course, on the best prospect projections. Under the high projection assumptions, by contrast, aerospace share of annual total exports would rise from an estimated 6 percent in 1975 to 10 percent in 1980. With the low conditions, the shares would be something like 4 percent in 1975 and 6 percent in 1980. This means that the overseas market is expected to remain significant for the aerospace industry throughout the decade, despite annual fluctuations. And, equally as important, aerospace sales can be expected to continue to carry their past value to the contry in respect to its trade relations abroad.

5

EMERGING MARKETS

Although the aerospace industry's efforts to diversify and expand into markets outside the conventional aircraft, missiles, and space, demand categories have not been of major dimensions, neither have they been trivial. This section examines some of the past trends, as well as some potential market areas that appear to represent possible objectives for further diversification.

As noted, recent sales of non-aerospace products by aerospace firms have run at around the $2 billion level, or a fairly constant 10 to 11 percent of total defense. space, commercial aircraft, general aviation, and parts and accessories sales. These non-aerospace products have ranged as widely as computerized blood bank inventory control systems, modular housing, vehicle traffic monitoring systems, and new energy generating systems.

It is clear that merely projecting the recently observed ratio of non-aerospace to total industry sales for the rest of the decade is not a sustainable assumption if, as is well known, the industry has a substantial interest in diversifying in order to make better use of its technological capabilities. Discussion on this matter begins with a broad consideration of national needs. National needs in the largest sense are served generally through gross national productive activities. Meeting these needs is shared between the public and private sectors of the economy. The public proportion of the Gross National Product has shifted gradually from 20 to about 23 percent between 1960 and 1970. In general, these public outlays reflect the increasing social and economic complexity of modern American conditions. From a perspective that sees

the vast majority of national resources committed as a result of private decisions, these governmental outlays are typically necessary either to complement or offset the social consequences of private activities, or to undertake activities that cannot be done on the necessary scale privately.

Whether society has correctly allocated its resources in response to its needs is, of course, difficult to determine, since one individual's assignment of value or importance can, and very often does, differ from another's. Of considerable importance to aerospace, in any case, is the potential markets that these allocations represent, particularly in the public sectors, since it is here that the industry's skills of systems analysis, high technology-based production methods and products, and program management are most relevant. The Federal Government's budgetary outlays by function provides the simplest index of broad prospects. Table 17, Appendix, portrays the federal budgetary outlays for the ten years of the decade and apportioned in basic categories such as defense, international affairs, space research and technology, and so forth. The best prospect growth in outlays from $205 to $337.5 billion through the decade was based on the recent experience of approximately 1.3 percent annual growth in Federal Government expenditures for goods and services plus transfer payments increases of approximately 7 percent annually. In the bottom portion of the table, the percentage distributions of the 1970, 1975, and 1980 budgets are given to illustrate the projected shifts in shares among the twelve categories. As can be seen, the significant changes are in defense (declining to 25 percent of all outlays, compared with 38 percent in 1970) and income security (which is projected to rise to 39 percent in 1980, up from the 31 percent of 1970). Other lesser changes are spread among the remaining elements.

Table 17 expresses federal budgetary outlays and thus, by definition, includes both expenditures for goods and services as well as transfer payments. A more meaningful view for emerging market consideration is given by the goods and services portion of budget outlays. Table 4, Appendix, shows the best prospect projection for goods and services expenditures for both the Federal Government and state and local

governments. As can be readily seen, Federal Government goods and services expenditures run to just under half the totals in the early part of the decade, and drop to 39 percent by 1980. From another standpoint, federal outlays for goods and services drop from just under a half of the total federal budget in 1970 to about a third of the budget in 1980. Over the decade, federal goods and services outlays are projected to increase about 15 percent, which merely illustrates again the well-known tendency for the federal budget to increase more significantly in the transfer payments and other obligatory outlays than in direct expenditures.

On the grounds that the Federal Government goods and services outlays represent the most logical focus of further aerospace diversification efforts, several functions of interest other than defense and space may be considered, viz. natural resources (denoting environment and pollution concerns), commerce and transportation, housing, health, and education (to use official U.S. Budget account designations). To obtain estimates of the goods and services expenditures for both federal and state and local governments for these selected categories, the following method of estimation was used. First, the ratio of federal goods and services expenditures to total budgetary outlays was computed for each selected category for the years 1967-1970 and deriving from this a four-year average ratio. Then, for the same period of time a coefficient was developed to estimate the state and local government expenditures for goods and services. This coefficient was determined by taking total state and local purchases of goods and services and dividing it by the total federal outlays minus federal goods and services expenditures. The resulting coefficient was then applied to each category of interest. Each of these categories will be examined briefly.

NATURAL RESOURCES AND ENVIRONMENT

Environmental quality is by now a byword in American society. The true costs of environmental degradation have never been calculated. Society's current judgment, as expressed in budgetary outlays for research and development in air, water, noise, solid waste, and the like, are merely the first approximation to the markets the aerospace industry might seek further to penetrate. Table 18, Appendix, portrays the

estimated expenditures for the various governmental levels' expenditures in this category and indicates an aggregate rise from 1970 outlays of about $6 billions up to just over $17 billion. This increase is about equally shared between the federal and state and local levels. The various federal programs for alleviation and control of air and water pollution intended to improve the quality of environment and to protect natural resources are presently functioning at amounts considerably below those authorized by existing legislation.

COMMERCE AND TRANSPORTATION

Governmental expenditures for goods and services associated with this critical area of social need are displayed in Table 19, Appendix. As can be seen, the total outlays are projected to increase to almost double present level, with the largest share of expenditures occurring at state and local levels. Highway construction is, of course, the principal claimant on these resources, although mass transit assistance and airport and airway development expenditures are also included in lesser shares. It will be clear from Table 19 that many of the state and local expenditure estimates are the result of either federal grants-in-aid programs or, for the future, some form of revenue sharing.

HOUSING AND COMMUNITY DEVELOPMENT

With ambitious goals of 25 million housing units between 1969-78 and associated upgrading of many community facilities, goods and services expenditures for housing and community development are projected to increase substantially from the 1970 levels. As can be seen from Table 20, Appendix, federal outlays are projected to rise four-fold by 1980, reaching $4 billion, while state and local expenditures will go up almost nine times, from $1 to $8.7 billion. Much of this spending will be for infrastructure and public facility construction or improvements. But new housing technology demands, perhaps best exemplified in Operation Breakthrough, represent possible growth opportunities. It will be noted, of course, that the strictly R&D elements in the estimates of Table 20 are relatively small and, at the federal level, run only around

$45 million; the remainder covers a broad and complex set of programs in rehabilitation, subsidization, mortgage guarantees, subsidization of low-rent public housing, and the like.

EDUCATION

While not directly tied to aerospace industry capabilities, education goods and services expenditures represent a large portion of total governmental outlays annually. As can be seen from Table 21, Appendix, these expenditures are projected to increase almost three times between 1970 and 1980. Most of the spending will, of course, be done at the state and local levels, as has been the case in the past. Education technology and concern over possible improvements in the educational delivery system is presently in a condition of uncertainty and exploration. Hopefully, the growing amount of research committed to education will help to stabilize activities to the point that more productive implementation and "production" of educational services can be begun.

HEALTH

In 1970 public and private expenditures for health care represented about 7 percent of the GNP, roughly $68 billion. Two-thirds of this substantial outlay was private, one-third public. Despite the amounts expended, it is well-recognized that American health care has not produced a good health record. While other factors may be involved (such as environmental conditions and the pace and pressure of modern life), it is nonetheless evident that dramatic increases in the cost of health care explains a large part of the failure to furnish more and better quality care throughout the country. Cost increases reflect both stronger demands for more and improved care, as well as insufficient improvements on the supply side in respect to medical manpower, hospital, and other health delivery systems.

In the face of this serious national problem, it is reasonable to expect further increases in the public expenditures needed to try to counter some of the evident deficiencies. Table 22, Appendix, accordingly, projects the governmental goods

and services expenditures for health. It indicates a little more than double the $14 billion spending in 1970 by the end of the decade, with the state and local units accounting for the largest proportion of the total. These outlays cover a wide variety of health care expenditures, but among them are funds for technological improvements in delivery and information systems.

Taken together, then, these projected outlays for goods and services in the selected categories do not by themselves form the exact market accessible to the aerospace industry. The dollar estimates obviously include some factors that are not truly relevant to the industry's skills of systems analysis, high technology production methods, and program management capabilities. But there is still a message in the estimates, inasmuch as they stand against a current sales level of about $2.2 billion annually in the non-aerospace product market by companies in the industry. The potential markets for the industry's skills appear to exceed by substantial margins the levels at which the industry presently operates.

APPENDIX A

TABLES

Table 1

PROJECTIONS OF GROSS NATIONAL PRODUCT, 1971 TO 1980
(in billions of 1970 dollars)

Calendar Year	Best Prospect	High Projection	Low Projection
1970 (actual)	974.1	974.1	974.1
1971	1045.8	1045.8	1045.8
1972	1086.9	1090.6	1082.8
1973	1136.0	1149.0	1122.8
1974	1185.0	1200.4	1164.6
1975	1236.5	1256.2	1208.9
1976	1291.7	1317.2	1254.3
1977	1346.5	1377.9	1301.3
1978	1406.4	1445.6	1350.1
1979	1466.3	1513.2	1401.0
1980	1529.0	1584.0	1454.0

Table 2

PROJECTIONS OF PERSONAL CONSUMPTION SERVICES, DURABLES, AND NON-DURABLES
(in billions of 1970 dollars)

Calendar Year	Personal Consumption		
	Total	Services	Durables and Non-durables
Best Prospect			
1970 (actual)	615.8	262.5	353.5
1971	659.8	266.9	392.9
1972	690.9	280.9	410.0
1973	723.5	295.7	427.8
1974	757.5	311.2	446.3
1975	793.3	327.5	465.8
1976	830.8	344.7	486.1
1977	870.1	362.8	507.3
1978	911.1	381.8	529.3
1979	954.3	401.9	552.4
1980	999.4	423.0	576.4
High Projection			
1970 (actual)	615.8	262.5	353.3
1971	659.8	266.9	392.9
1972	690.9	282.0	408.9
1973	726.1	297.9	428.2
1974	763.1	314.7	448.4
1975	802.0	332.5	469.5
1976	842.9	351.3	491.6
1977	885.9	371.1	514.8
1978	931.1	392.1	539.0
1979	978.6	414.3	564.3
1980	1028.5	437.7	590.8
Low Projection			
1970 (actual)	615.8	262.5	353.3
1971	659.8	266.9	392.9
1972	687.5	279.6	407.9
1973	716.4	292.9	423.5
1974	746.5	306.8	439.7
1975	777.9	321.4	456.5
1976	810.6	336.7	473.9
1977	844.6	352.7	491.9
1978	880.1	369.5	510.6
1979	917.1	387.1	530.0
1980	955.6	405.5	550.1

Table 3

PROJECTIONS OF GROSS PRIVATE DOMESTIC INVESTMENT AND PRODUCERS DURABLES, 1971 TO 1980

(in billions of dollars)

Galendar Year	Total	Producers Durables	Other
Best Prospect			
1970 (actual)	135.3	65.4	69.9
1971	151.1	65.6	85.5
1972	156.3	69.5	86.8
1973	162.9	73.7	89.2
1974	172.7	78.1	94.6
1975	183.0	82.8	100.2
1976	194.0	87.8	106.2
1977	204.7	93.1	111.6
1978	216.0	98.6	117.4
1979	227.8	104.6	123.2
1980	240.4	110.8	129.6
High Projection			
1970 (actual)	135.3	65.4	69.9
1971	151.1	65.6	85.5
1972	158.6	69.5	89.1
1973	166.6	73.3	93.3
1974	174.9	77.3	97.6
1975	185.4	82.3	103.1
1976	195.6	87.6	108.0
1977	208.3	93.3	115.0
1978	220.8	99.4	121.4
1979	234.1	105.9	128.2
1980	248.1	112.8	135.3
Low Projection			
1970 (actual)	135.3	65.4	69.9
1971	151.1	65.6	85.5
1972	155.6	68.6	87.0
1973	161.8	71.7	90.1
1974	168.3	74.9	93.4
1975	175.8	78.6	97.2
1976	183.8	82.5	101.3
1977	192.1	86.6	105.5
1978	200.7	90.9	109.8
1979	209.7	95.4	114.3
1980	219.2	100.2	119.0

Table 4

PROJECTIONS OF GOVERNMENT EXPENDITURES
FOR PURCHASES OF GOODS AND SERVICES, 1971 TO 1980
(in billions of 1970 dollars)

Calendar Year	Total Government	Federal Government	State and Local Government
Best Prospect			
1970 (actual)	219.4	97.2	122.2
1971	237.1	100.0	137.1
1972	241.2	101.2	140.0
1973	250.4	102.5	147.9
1974	254.7	104.0	150.7
1975	259.2	105.1	154.1
1976	265.7	106.4	159.3
1977	270.2	107.7	162.5
1978	277.7	109.1	168.6
1979	282.4	110.4	172.0
1980	287.2	111.8	175.4
High Projection			
1970 (actual)	219.4	97.2	122.2
1971	237.1	100.0	137.1
1972	241.2	101.2	140.0
1973	253.0	105.1	147.9
1974	258.4	107.7	150.7
1975	264.5	110.4	154.1
1976	272.4	113.1	159.3
1977	278.5	116.0	162.5
1978	287.5	118.9	168.6
1979	293.8	121.8	172.0
1980	300.3	124.9	175.4
Low Projection			
1970 (actual)	219.4	97.2	122.2
1971	237.1	100.0	137.1
1972	241.2	101.2	140.0
1973	245.4	102.5	142.9
1974	249.7	104.0	145.7
1975	254.2	105.1	149.1
1976	258.7	106.4	152.3
1977	263.2	107.7	155.5
1978	267.7	109.1	158.6
1979	272.4	110.4	162.0
1980	277.2	111.8	165.4

Table 5

PROJECTIONS OF NET EXPORTS OF GOODS AND SERVICES
(in billions of 1970 dollars)

Calendar Year	Best Prospect	High	Low
1970 (actual)	3.6	3.6	3.6
1971	-2.2	-2.2	-2.2
1972	- .7	- .1	-1.5
1973	1.0	3.3	- .8
1974	1.5	4.0	.1
1975	2.0	4.3	1.0
1976	2.5	4.4	1.2
1977	3.0	5.2	1.4
1978	3.5	6.2	1.6
1979	4.0	6.7	1.8
1980	4.0	7.1	2.0

Table 6

PROJECTION OF MILITARY MANPOWER AND DEFENSE OUTLAYS 1971 TO 1980
(in billions of 1970 dollars)

Best Prospect

Calendar Year	Manpower (in millions)	Military Personnel	Operations and Maintenance	Military Construction	Defense Family Housing	RDT&E	Procurement			Total
							Total	Aircraft	Missiles	
1970 (actual)	3.1	25.4	21.0	1.20	.61	7.2	20.0	7.3	3.0	75.4
1971	2.8	24.6	20.3	1.35	.67	7.4	18.3	6.2	3.2	72.6
1972	2.7	24.0	20.0	1.25	.67	7.8	21.0	6.2	3.5	74.7
1973	2.5	23.6	19.8	1.25	.75	7.8	22.0	6.4	3.8	75.2
1974	2.3	23.2	18.5	1.25	.83	7.8	22.0	6.6	3.6	73.6
1975	2.3	24.7	18.0	1.35	.85	8.0	21.6	6.8	3.6	74.5
1976	2.3	25.6	18.0	1.35	.86	8.2	20.0	7.2	3.3	74.0
1977	2.3	26.8	18.9	1.45	.87	8.4	19.0	7.3	3.2	75.4
1978	2.3	28.0	19.8	1.45	.88	8.6	19.0	7.3	3.2	77.7
1979	2.3	29.3	20.0	1.50	.89	8.8	19.0	7.2	3.0	79.5
1980	2.3	30.6	20.0	1.50	.90	9.0	18.6	6.7	2.8	80.6
Low Projection										
1970 (actual)	3.1	25.4	21.0	1.20	.61	7.2	20.0	7.3	3.0	75.4
1971	2.8	24.6	20.3	1.35	.67	7.4	18.3	6.2	3.2	72.6
1972	2.7	24.0	20.0	1.25	.67	7.8	21.0	6.2	3.5	74.7
1973	2.4	22.7	19.8	1.25	.75	7.8	20.5	6.4	3.6	72.8
1974	2.0	22.3	17.0	1.25	.83	7.8	19.5	6.0	3.6	68.7
1975	2.0	21.7	16.5	1.35	.85	7.8	18.8	6.0	3.1	67.0
1976	2.0	22.8	16.0	1.35	.86	7.8	17.1	6.0	2.8	65.9
1977	2.0	23.9	16.4	1.45	.87	7.8	17.3	6.0	2.8	67.7
1978	2.0	25.0	17.2	1.45	.88	7.8	17.4	5.5	2.6	69.7
1979	2.0	26.1	18.1	1.50	.89	7.8	15.6	5.0	2.4	70.0
1980	2.0	27.2	19.0	1.50	.90	7.8	13.9	4.0	2.1	70.3
High Projection										
1970 (actual)	3.1	25.4	21.0	1.20	.61	7.2	20.0	7.3	3.0	75.4
1971	2.8	24.6	20.3	1.35	.67	7.4	18.3	6.2	3.2	72.6
1972	2.7	24.0	20.0	1.25	.67	7.8	21.9	6.2	3.5	75.6
1973	2.6	23.6	19.8	1.25	.75	7.8	23.0	7.0	3.8	76.2
1974	2.5	24.9	19.0	1.25	.83	7.8	22.5	7.4	3.8	77.3
1975	2.5	26.1	18.6	1.35	.85	8.0	22.0	7.8	3.8	78.2
1976	2.5	27.4	19.5	1.35	.86	8.2	22.0	7.8	3.8	80.6
1977	2.5	28.7	20.5	1.45	.87	8.4	22.0	7.8	3.8	83.4
1978	2.5	30.0	21.5	1.45	.88	8.6	22.0	7.8	3.8	84.8
1979	2.5	31.4	22.6	1.50	.89	8.8	22.0	7.8	3.8	88.4
1980	2.5	32.8	23.7	1.50	.90	9.0	22.0	7.8	3.8	91.2

Excludes Foreign Military Assistance

Table 7

DEPARTMENT OF DEFENSE PROJECTIONS FOR PRODUCTS OF THE AEROSPACE INDUSTRY, 1971-1980
(in billions of 1970 dollars)

Calendar Year	Aircraft	Missiles	Aircraft and Missile R&D	Total
Best Prospect				
1970 (actual)	7.3	3.0	4.4	14.7
1971	6.2	3.2	4.3	13.7
1972	6.2	3.5	4.3	14.0
1973	6.4	3.8	4.5	14.7
1974	6.6	3.6	4.5	14.7
1975	6.8	3.6	4.5	14.9
1976	7.2	3.3	4.5	15.0
1977	7.3	3.2	4.5	15.0
1978	7.3	3.2	4.5	15.0
1979	7.2	3.0	4.5	14.7
1980	6.7	2.8	4.5	14.0
High Projection				
1970 (actual)	7.3	3.0	4.4	14.7
1971	6.2	3.2	4.3	13.7
1972	6.2	3.5	4.3	14.0
1973	7.0	3.8	4.5	15.3
1974	7.4	3.8	4.5	15.7
1975	7.8	3.8	4.5	16.1
1976	7.8	3.8	4.7	16.3
1977	7.8	3.8	4.8	16.4
1978	7.8	3.8	4.9	16.5
1979	7.8	3.8	5.0	16.6
1980	7.8	3.8	5.0	16.6
Low Projection				
1970 (actual)	7.3	3.0	4.4	14.7
1971	6.2	3.2	4.3	13.7
1972	6.2	3.5	4.3	14.0
1973	6.4	3.8	4.3	14.5
1974	6.6	3.6	4.2	14.4
1975	6.0	3.1	4.2	13.3
1976	6.0	2.8	4.1	12.9
1977	6.0	2.8	4.1	12.9
1978	5.5	2.8	4.0	12.3
1979	5.0	2.4	4.0	11.4
1980	4.0	2.1	4.0	10.1

Table 8

ESTIMATES OF PROJECTED BUDGET ALLOCATIONS AND DEMAND BY NASA FOR THE PERIOD 1971-1980
(in billions of 1970 dollars)

Calendar Year	Total NASA Funding Level			Amount Available to Aerospace Contractors		
	Best Prospect	High	Low	Best Prospect	High	Low
1970 (actual)	3.4	--	--	2.6	--	--
1971	3.3	3.4	3.3	2.6	2.6	2.5
1972	3.3	3.3	3.3	2.4	2.5	2.5
1973	3.3	3.4	3.3	2.4	2.6	2.5
1974	3.3	3.5	3.3	2.4	2.7	2.5
1975	3.4	4.0	3.3	2.5	3.1	2.5
1976	3.6	4.5	3.3	2.8	3.5	2.5
1977	3.7	4.7	3.3	2.6	3.6	2.5
1978	3.9	4.7	3.3	2.9	3.6	2.5
1979	4.0	4.6	3.3	3.0	3.5	2.5
1980	4.1	4.6	3.3	3.2	3.5	2.5

Notes: Amounts available to aerospace contractors are based on a six-year average percentage of total NASA funds, discounted for federal operating expenditures, non-profit and university grants, and construction costs.

Source: RMC calculations based on AIA data, the U.S. Budget and NASA's Annual Procurement Reports.

Table 9

PROJECTIONS OF FREE WORLD DEMAND FOR U.S. MANUFACTURED COMMFRCIAL AIRCRAFT, 1971 TO 1980

Best Prospect Estimate

Calendar Year	Total Free World Seat Mile Demand	Annual New Free World Seat Mile Demand	Total Free World New Aircraft Demand	U.S. Airlines Demand for U.S. Manufactured Aircraft	Foreign Demand for U.S. Manufactured Aircraft (Exports)	Total Demand for U.S. Manufactured Aircraft
	(in billions)		(in billions of 1970 dollars)			
1970 (actual)	522.7	89.2	N/A	2.2	1.3	3.5
1971	575.0	62.8	3.5	1.2	1.8	3.0
1972	632.5	69.0	2.7	1.4	.8	2.2
1973	695.7	75.9	3.1	1.5	.9	2.5
1974	765.3	83.5	3.6	1.6	.9	2.5
1975	841.8	91.8	4.1	1.8	1.1	2.9
1976	926.0	101.0	4.6	2.0	1.2	3.2
1977	1000.1	92.6	4.2	1.8	1.1	2.9
1978	1080.9	100.8	4.8	2.1	1.3	3.4
1979	1166.5	107.2	5.5	2.4	1.4	3.8
1980	1259.8	116.6	6.2	2.8	1.6	4.4

Table 10

PROJECTIONS OF FREE WORLD DEMAND FOR U.S. MANUFACTURED COMMERCIAL AIRCRAFT, 1971 TO 1980

High Projection

Calendar Year	Total Free World Seat Mile Demand	Annual New Free World Seat Mile Demand	Total Free World New Aircraft Demand	U.S. Airlines Demand for U.S. Manufactured Aircraft	Foreign Demand for U.S. Manufactured Aircraft (Exports)	Total Demand for U.S. Manufactured Aircraft
	(in billions)		(in billions of 1970 dollars)			
1970 (actual)	522.7	89.2	N/A	2.2	1.3	3.5
1971	575.0	62.8	3.5	1.2	1.8	3.0
1972	644.0	80.5	3.2	1.6	1.0	2.6
1973	721.3	90.2	3.7	1.8	1.1	2.9
1974	807.9	101.0	4.3	2.2	1.3	3.4
1975	904.8	113.1	5.0	2.5	1.5	4.0
1976	1013.4	126.7	5.8	2.9	1.7	4.6
1977	114.7	121.6	5.5	2.7	1.6	4.4
1978	1226.2	133.8	6.4	3.2	1.9	5.2
1979	1348.8	147.1	7.5	3.8	2.2	6.0
1980	1483.7	161.9	8.6	4.3	2.6	6.9

Table 11

PROJECTIONS OF FREE WORLD DEMAND FOR U.S. MANUFACTURED COMMERCIAL AIRCRAFT, 1971 TO 1980

Low Projection

Calendar Year	Total Free World Seat Mile Demand	Annual New Free World Seat Mile Demand	Total Free World New Aircraft Demand	U.S. Airlines Demand for U.S. Manufactured Aircraft	Foreign Demand for U.S. Manufactured Aircraft (Exports)	Total Demand for U.S. Manufactured Aircraft
	(in billions)		(in billions of 1970 dollars)			
1970 (actual)	522.7	89.2	N/A	2.2	1.3	3.5
1971	564.5	52.3	3.5	1.2	1.8	3.0
1972	609.7	56.5	2.2	1.1	.7	1.8
1973	658.5	63.0	2.6	1.3	.8	2.0
1974	711.1	56.8	2.4	1.0	.7	1.8
1975	768.0	71.1	3.2	1.3	.9	2.3
1976	829.5	76.9	3.5	1.5	1.1	2.5
1977	895.8	82.9	3.7	1.6	1.1	2.8
1978	967.5	89.6	4.3	1.9	1.3	3.2
1979	1044.9	96.7	4.9	2.2	1.5	3.7
1980	1128.5	104.5	5.5	2.4	1.7	4.1

Table 13

PROJECTIONS OF THE DEMAND FOR GENERAL AVIATION PRODUCTS
(in billions of 1970 dollars)

Calendar Year	Total	U.S. Domestic	Export
Best Prospect			
1970 (actual)	.425	.300	.125
1971	.500	.340	.160
1972	.600	.420	.180
1973	.800	.600	.200
1974	1.000	.780	.220
1975	1.200	.960	.240
1976	1.300	1.040	.260
1977	1.400	1.120	.280
1978	1.500	1.200	.300
1979	1.550	1.230	.320
1980	1.600	1.260	.340
High Projection			
1970 (actual)	.425	.300	.125
1971	.500	.340	.160
1972	.700	.500	.200
1973	.900	.660	.240
1974	1.100	.820	.280
1975	1.300	1.000	.300
1976	1.450	1.130	.320
1977	1.575	1.235	.340
1978	1.700	1.340	.360
1979	1.800	1.420	.380
1980	1.900	1.500	.400
Low Projection			
1970 (actual)	.425	.300	.125
1971	.500	.340	.160
1972	.500	.340	.160
1973	.550	.380	.170
1974	.600	.420	.180
1975	.650	.460	.190
1976	.700	.500	.200
1977	.750	.540	.210
1978	.800	.580	.220
1979	.900	.660	.240
1980	1.000	.720	.280

Table 14

PROJECTIONS OF AIRCRAFT PARTS, ACCESSORIES, AND EQUIPMENT FOR AIRCRAFT, INCLUDING SPARES, 1971-1980
(in billions of 1970 dollars)

Calendar Year	Total	U.S. Domestic	Export
Best Prospect			
1970 (actual)	1.3	.7	.6
1971	1.2	.1	1.1
1972	1.3	.5	.8
1973	1.4	.6	.8
1974	1.5	.7	.8
1975	1.6	.8	.8
1976	1.7	.9	.8
1977	1.8	1.0	.8
1978	1.9	1.0	.9
1979	2.0	1.0	1.0
1980	2.1	1.1	1.0
High Projection			
1970 (actual)	1.3	.7	.6
1971	1.2	.1	1.1
1972	1.3	.5	.8
1973	1.5	.7	.8
1974	1.7	.9	.8
1975	1.9	1.0	.9
1976	2.1	1.1	1.0
1977	2.3	1.2	1.1
1978	2.5	1.3	1.2
1979	2.7	1.4	1.3
1980	2.9	1.5	1.4
Low Projection			
1970 (actual)	1.3	.7	.6
1971	1.2	.1	1.1
1972	1.3	.5	.8
1973	1.3	.6	.7
1974	1.4	.7	.7
1975	1.4	.7	.7
1976	1.5	.8	.7
1977	1.5	.8	.7
1978	1.6	.9	.7
1979	1.6	.9	.7
1980	1.7	.9	.8

Table 15

PROJECTIONS OF DEMAND FOR PRODUCTS OF THE AEROSPACE INDUSTRY, 1971-1980
(in billions of 1970 dollars)

Calendar Year	Department of Defense			Space	Commercial Transport Aircraft	General Aviation	All Cargo Aircraft	Aircraft Parts, Accessories, & Equipment for Aircraft, Including Spares	Non-Aerospace Products	Total
	Aircraft	Missiles	Aircraft and Missile R&D							
Best Prospect										
1970 (actual)	7.3	3.0	4.4	2.6	3.5	.5		1.3	2.2	24.8
1971	6.2	3.2	4.3	2.6	3.0	.5		1.2	2.1	23.1
1972	6.2	3.5	4.3	2.4	2.2	.6		1.3	2.1	22.6
1973	6.4	3.8	4.5	2.4	2.5	.8		1.4	2.2	24.0
1974	6.6	3.6	4.5	2.4	2.5	1.0		1.5	2.2	24.3
1975	6.8	3.6	4.5	2.5	2.9	1.2	.1	1.6	2.3	25.5
1976	7.2	3.3	4.5	2.8	3.2	1.3	.2	1.7	2.4	26.6
1977	7.3	3.2	4.5	2.6	2.9	1.4	.2	1.8	2.4	26.3
1978	7.3	3.2	4.5	2.9	3.4	1.5	.4	1.9	2.5	27.6
1979	7.2	3.0	4.5	3.0	3.8	1.5	.6	2.0	2.6	28.2
1980	6.7	2.8	4.5	3.2	4.4	1.6	.8	2.1	2.6	28.7
High Projection										
1970 (actual)	7.3	3.0	4.4	2.6	3.5	.5		1.3	2.2	24.8
1971	6.2	3.2	4.3	2.6	3.0	.5		1.2	2.1	23.1
1972	6.2	3.5	4.3	2.4	2.6	.7		1.3	2.1	23.1
1973	7.0	3.8	4.5	2.6	2.9	.9		1.5	2.3	25.5
1974	7.4	3.8	4.5	2.7	3.4	1.1		1.7	3.0	27.6
1975	7.8	3.8	4.5	3.1	4.1	1.3	.1	1.9	3.2	29.8
1976	7.8	3.8	4.7	3.5	4.6	1.4	.2	2.1	3.4	31.5
1977	7.8	3.8	4.8	3.6	4.4	1.6	.3	2.3	4.3	32.9
1978	7.8	3.8	4.9	3.6	5.2	1.7	.5	2.5	4.6	34.6
1979	7.8	3.8	5.0	3.5	6.0	1.8	.7	2.7	4.7	36.0
1980	7.8	3.8	5.0	3.5	6.9	1.9	1.0	2.9	4.9	37.7
Low Projection										
1970 (actual)	7.3	3.0	4.4	2.6	3.5	.5		1.3	2.2	24.8
1971	6.2	3.2	4.3	2.6	3.0	.5		1.2	2.0	23.0
1972	6.2	3.5	4.3	2.4	1.8	.5		1.3	2.0	22.0
1973	6.4	3.8	4.3	2.5	2.0	.6		1.3	2.1	23.0
1974	6.6	3.6	4.2	2.5	1.8	.6		1.4	2.1	22.8
1975	6.0	3.1	4.2	2.5	2.3	.6	.1	1.4	2.0	22.2
1976	6.0	2.8	4.1	2.5	2.5	.7	.1	1.5	2.0	22.2
1977	6.0	2.8	4.1	2.5	2.8	.8	.2	1.5	2.1	22.8
1978	5.5	2.8	4.0	2.5	3.2	.8	.3	1.6	2.0	22.7
1979	5.0	2.4	4.0	2.5	3.7	.9	.5	1.6	2.1	22.7
1980	4.0	2.1	4.0	2.5	4.1	1.0	.7	1.7	2.0	22.1

Table 16

PROJECTIONS OF U.S. EXPORTS OF NON-MILITARY AEROSPACE PRODUCTS
(in billions of 1970 dollars)

Calendar Year	Total Exports	U. S. Commercial Transport Aircraft	U. S. Commercial Cargo Aircraft	General Aviation Aircraft	Parts, Accessories and Equipment for Aircraft, Including Spares	Used Aircraft and Engines, New and Used
Best Prospect						
1970 (actual)	2.2	1.3		.12	.6	.2
1971	3.5	1.8		.16	1.1	.4
1972	2.8	1.5		.18	.8	.3
1973	2.3	1.0		.20	.8	.3
1974	2.3	1.0		.22	.8	.3
1975	2.5	1.1	.03	.24	.8	.3
1976	2.6	1.2	.06	.26	.8	.3
1977	2.6	1.1	.10	.28	.8	.3
1978	3.0	1.3	.16	.30	.9	.3
1979	3.3	1.4	.24	.32	1.0	.3
1980	3.6	1.6	.32	.34	1.0	.3
High Projection						
1970 (actual)	2.2	1.3		.12	.6	.2
1971	3.5	1.8		.16	1.1	.4
1972	3.0	1.7		.20	.8	.3
1973	2.5	1.2		.24	.8	.3
1974	2.8	1.4		.28	.8	.3
1975	3.0	1.5	.04	.30	.9	.3
1976	3.4	1.7	.07	.32	1.0	.3
1977	3.5	1.6	.12	.34	1.1	.3
1978	4.0	1.9	.20	.36	1.2	.3
1979	4.5	2.2	.29	.38	1.3	.3
1980	5.1	2.6	.38	.40	1.4	.3
Low Projection						
1970 (actual)	2.2	1.3		.12	.6	.2
1971	3.5	1.8		.16	1.1	.4
1972	2.8	1.5		.16	.8	.3
1973	2.1	.9		.17	.7	.3
1974	2.0	.8		.18	.7	.3
1975	2.1	.9	.02	.19	.7	.3
1976	2.4	1.1	.05	.20	.7	.3
1977	2.4	1.1	.09	.21	.7	.3
1978	2.7	1.3	.14	.22	.7	.3
1979	2.5	1.5	.21	.24	.7	.3
1980	3.4	1.7	.28	.28	.8	.3

Table 17

FEDERAL OUTLAYS
(billions of 1970 dollars)

Calendar Year	Total	National Defense	International Affairs	Space Research and Technology	Agriculture and Rural Development	Natural Resources	Commerce and Transportation	Community Development and Housing	Education	Health	Income Security and Labor	Veterans Benefits	Interest	General Government
Best Prospect														
1970 (actual)	205.1	78.6	2.8	3.6	5.1	2.9	10.0	2.7	5.4	3.3	59.7	9.8	14.7	6.5
1971	215.0	75.0	3.5	3.4	5.4	3.0	11.0	3.9	6.4	4.3	65.1	10.0	16.5	7.4
1972	227.7	77.1	4.0	3.3	5.6	3.5	11.5	4.2	7.0	4.5	70.3	10.2	18.0	8.5
1973	242.7	77.6	4.2	3.4	5.8	4.0	12.0	4.6	7.5	4.8	80.4	10.4	19.0	9.0
1974	253.6	76.0	4.4	3.5	6.0	4.5	13.0	5.0	8.0	5.2	87.7	10.8	20.0	9.5
1975	264.4	77.5	4.5	4.0	6.0	5.0	13.4	5.5	9.0	5.5	92.0	11.0	21.0	10.0
1976	278.6	77.0	4.7	4.5	6.2	5.5	15.0	6.0	11.0	6.0	98.6	11.5	22.0	10.6
1977	291.3	78.4	4.9	4.6	6.4	6.0	16.0	7.0	12.0	6.5	103.3	12.0	23.0	11.2
1978	307.9	80.7	5.0	4.6	6.6	7.0	16.8	7.8	13.5	7.5	110.2	12.4	24.0	11.8
1979	322.2	82.5	5.2	4.6	6.8	8.0	17.5	8.8	14.0	8.0	116.6	12.8	25.0	12.4
1980	337.5	83.6	5.5	4.6	7.0	9.0	19.0	10.3	15.0	8.5	123.0	13.0	26.0	13.0
Percent														
1970	1.000	.383	.014	.018	.025	.014	.049	.013	.026	.016	.291	.048	.072	.032
1975	1.000	.293	.017	.015	.023	.019	.051	.021	.034	.021	.348	.042	.079	.038
1980	1.000	.248	.016	.014	.021	.027	.056	.031	.044	.025	.364	.038	.077	.038

Table 18

NATURAL RESOURCES AND ENVIRONMENT GOODS AND SERVICES EXPENDITURES
(billions of 1970 dollars)

Calendar Year	Total	Federal	State and Local
1970 (actual)	5.9	2.7	3.2
1971	6.4	2.8	3.6
1972	7.6	3.2	4.4
1975	10.5	4.6	5.9
1980	17.2	8.4	8.8

Table 19

COMMERCE AND TRANSPORTATION GOODS AND SERVICES EXPENDITURES
(billions of 1970 dollars)

Calendar Year	Local	Federal	State and Local
1970 (actual)	25.7	4.1	21.6
1971	28.4	4.5	23.9
1972	29.7	4.7	25.0
1975	34.6	5.5	29.1
1980	49.0	7.8	41.2

Table 20

COMMUNITY DEVELOPMENT AND HOUSING GOODS AND SERVICES EXPENDITURES
(billions of 1970 dollars)

Calendar Year	Total	Federal	State and Local
1970 (actual)	2.2	1.0	1.2
1971	4.8	1.6	3.2
1972	5.2	1.7	3.5
1975	6.8	2.2	4.6
1980	12.8	4.1	8.7

Table 21

EDUCATION GOODS AND SERVICES EXPENDITURES
(billions of 1970 dollars)

Calendar Year	Local	Federal	State and Local
1970 (actual)	54.1	.9	53.2
1971	64.2	1.1	63.1
1972	70.2	1.2	69.0
1975	90.7	1.5	89.2
1980	151.3	2.5	148.8

Table 22

HEALTH GOODS AND SERVICES EXPENDITURES
(billions of 1970 dollars)

Calendar Year	Local	Federal	State and Local
1970 (actual)	13.8	1.5	12.3
1971	15.0	2.0	13.0
1972	16.1	2.1	14.0
1975	20.0	2.6	17.4
1980	30.0	4.0	26.0

APPENDIX B

ANALYSIS OF SELECTED INDUSTRY VARIABLES AND THEIR INTERACTIONS

APPENDIX B

In order to measure the relationships between economic variables in the aerospace industry, regression analysis was applied to annual data for the period from 1960 to 1970. From the results that follow, distinctly measurable relationships were developed that show how strongly sales were associated with net profits, employment, plant and equipment expenditures, and R&D expenditures, on pairing each one individually with sales. In a similar way, employment was correlated with payroll; R&D expenditures and profits were linked to value-added and investment in plant and equipment. In each instance, the parameter (i.e., the regression coefficient) in the accompanying table measures the linear relationship between two variables and the correlation coefficient indicates the strength of the relationship. If the changes in these variables remain roughly stable in a relative sense, projections of their future values in the aerospace industry can be made with some reliability. However, when one or more changes at a different rate than the others with which it is associated, projections will no longer be accurate.

STATISTICALLY SIGNIFICANT AEROSPACE INDUSTRY RELATIONSHIPS

Based on regression analysis of aerospace data for the period 1960 to 1970, the following significant relationships between the indicated variables are presented. All statistics and parameters representing these relationships appear in the

accompanying table.

(1) Additional aerospace sales of about $18.61 were registered for each dollar of net profit earned in the industry beyond the sales level of $12,974,300,000 (the function's intercept).

(2) A change in sales of about $29,155 occurred for each individual change in employment within the industry.

(3) A change in the employment of an individual worker was associated with a change in payroll of $16,849 at the margin.

(4) A variation in aerospace R&D expenditures of one million dollars was associated with a change in the employment of 103 workers in aerospace.

(5) A change of one million dollars in aerospace R&D expenditures by the Federal Government was associated with a change in employment of 130 aerospace workers, 92 of which were indicated to be salaried employees.

(6) The employment of 65 salaried workers was associated with a one-million dollar change in total aerospace R&D expenditures.

(7) Aerospace sales were about 4-1/4 times larger than total aerospace R&D funds, and federal funds to aerospace R&D comprised approximately 70 percent of total funds expended on aerospace R&D.

(8) About six cents in aerospace profits were correlated with a one dollar change in aerospace value-added.

(9) For each million dollars invested in aerospace plant and equipment, employment changed by approximately 477 workers.

(10) 445 salaried workers were employed per thousand aerospace workers.

(11) Approximately 100 dollars were invested in aerospace plant and equipment for every $1,268 in sales and net profits of 52 cents were realized for each dollar invested in plant and equipment, both relationships treating capital investment as a lagged variable--that is, profits and sales during one year were significantly related to plant and equipment expenditures during the following year.

SIGNIFICANT AEROSPACE INTRA-INDUSTRY RELATIONSHIPS DERIVED FROM EXISTING DATA FOR 1960-1970

Dependent Variable	Independent Variable	Regression Coefficient	Correlation Coefficient, "r"	Intercept	Used in Projections for 1971-1980
Mean (millions)	Mean (millions)	(Standard Error)	Determination Coefficient, "r^a"	Standard Error of Estimate	
Sales	Net Profit (after taxes)	18.61	.90	12974.3	X
22517.5	512.7	(3.05)	.81	1850.0	
Sales	Employment	29155.4	.91	-12977.8	X
22517.5	1.21745	(4337.7	.83	1709.5	
Payroll	Employment	16849.0	.86	-9940.1	X
10572.8	1.21745	(3395.8)	.74	1338.3	
Employment	Total R&D Expenditures in Aerospace	.000103	.69	.7	
1.21745	4964.55	(.000036)	.48	.095	
Employment	Federal R&D Exp's on Aerospace	.00013	.56	.67	
1.21745	4204.27	(.00006)	.31	.108	
Salaried Employees	Total R&D Exp's Aerospace	.000065	.86	.262	
.582	4964.55	(.000013)	.74	.034	
Salaried Employees	Federal R&D Aerospace Exp's	.000092	.80	.194	
.582	4204.27	(.000023)	.64	.040	
Net Profits	Value added	.0592	.91	-190.0	X
512.7	11867.6	(.0092	.83	85.6	
Employment	Fixed Capital Inv. Expenditures	.000477	.94	.938	X
1.21745	586.4	(.000057)	.88	.044	
Sales	Fixed Capital Investment	12.68	.73	14334.8	
21771.4	586.4	(3.92)	.53	3053.7	
Net Profits	Fixed Capital Investment	.524	.63	193.6	
513.9	611.0	(.226)	.40	165.8	
Sales	Total Aerospace R&D Expenditures	4.23	.89	1504.7	X
22517.5	4964.55	(0.73)	.78	1933.8	
Salaried Empl.	Total Employment	.445	.91	.028	X
.58291	1.21745	(.069)	.83	.027	
Total Aerospace R&D Exp's	Federal Gov't R&D Aerospace Exp's	1.43	.93	-1051.5	X
4964.55	4204.27	(.19)	.86	327.0	

No significant statistical relationships were determined between the following aerospace industry variables:

(1) production worker employment and total aerospace R&D expenditures,

(2) production worker employment and federal expenditures for aerospace R&D,

(3) changes in total aerospace employment lagged and total aerospace R&D expenditures,

(4) changes in total aerospace employment lagged and federal expenditures for aerospace R&D, and

(5) changes in total aerospace employment lagged and annual fixed capital expenditures in aerospace.

All of the functional relationships were derived from data representing a growing aerospace industry for the majority of years considered. However, when current data for 1971 were applied to the projection equations, some discrepancies in estimates were observed because employment and investment in plant and equipment expenditures changed (decreased) at a much greater rate than in past years. Therefore, adjustments had to be made to obtain currently known values for the variables.

The implication is that cross-sectional or pooled data models should be developed for short-run projections. However, the significant relationships developed for the past decade may be a satisfactory base on which to make ball-park estimates representing intra-industry relationships over the long run. Since these relationships represent the past long-run performance of the industry, there is a reasonable chance for the expressed relationships to be restored and stabilized.

Based on the best prospect of aerospace sales projected at annual intervals between 1970 and 1980, net profits, total employment, salaried-worker employment, value-added, payroll, R&D expenditures, Federal Government aerospace R&D funds, and expenditures on plant and equipment in aerospace were each projected for the industry. These projections for 1975 and 1980 are presented in the following table and are based on the statistically significant relationships previoulsy determined.

PROJECTED AEROSPACE INTRA-INDUSTRY RELATIONSHIPS
(in millions)

Year	Estimated Total Sales by Aerospace Companies	Net Profits After Taxes	Employment	Salaried Employees	Value Added	Payroll	Total R&D Funds	Federal Aerospace R&D Funds	Plant and Equipment Expenditures
1975	$25,520	$674	1.320	.629	14,595	$12,300.6	$5,677	$4,705	$ 787
1980	$28,600	$840	1.426	.677	17,399	$14,086.6	$6,406	$5,215	$1,090