AEROSPACE SYSTEMS SERIES

SOME MAJOR IMPACTS OF THE NATIONAL SPACE PROGRAM

V. Economic Impacts

Prepared for:

I.P. HALPERN
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
WASHINGTON, D.C.

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SOME MAJOR IMPACTS OF THE NATIONAL SPACE PROGRAM

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Principal Investigator: Roger W. Hough

Project Manager: John G. Meitner

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SRI Project MU-7227
NASA Contract NASW-1722

FOREWORD

This is the fifth in a series of task reports within a brief study of "Some Major Impacts of the National Space Program."

Within this investigation, many candidate impacts were first screened and those that appeared (a) minor and (b) not likely to yield to sufficient study within the short time available, were eliminated. The remaining impacts were subjected to further study, and each is separately reported within this series.*

The results of this study are the first concrete assays within a welter of conflicting, incomplete, exaggerated, and frequently unsupported information. Stanford Research Institute considers their objective study an important task and is looking forward to extend the scope of this study in the future, by application of the background, methodologies, and initial results obtained to date.

John G. Meitner
Project Manager

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* The titles are: "Economic Impacts," "Identification of New Occupations," "Impacts of New Materials Technology," "Impacts Upon Aviation and Aeronautics," "Impacts Upon Health, Biology, and Medicine," "Some Total Impacts of NASA Capability," "The Impact of the Space Program Upon Science--1. Astronomy."

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SUMMARY AND CONCLUSIONS

Recent studies have begun to show conclusive evidence of a dramatic relationship between advancing technology and economic growth. Although such a relationship seems intuitively obvious, the proof has been, and still is, considerably elusive. No clear, definitive, quantitative theory yet exists in the economic literature, although much attention has been paid to the subject in the past 10 years.

Since NASA is exclusively a research and development agency of the government, it is important that the relationship between R&D and economic growth be understood. This report discusses some aspects of the relationship and indicates some of the required ingredients for economic growth. These are, for example, a more productive work force, gained largely through education; a continuous building up of the store of knowledge; greater utilization of knowledge by entrepreneurs; and a high rate of utilization of human capital, first by virtue of low unemployment in all occupational categories and second by a continual development and utilization of higher skills.

To find out how NASA contributes to these various elements, this study examined to some extent the role of the Agency in extending the quality of environment at its centers and production and test areas in the South. It was found that by contributing to improvements in local educational systems, NASA had effectively modified the direction of growth taking place in a number of locations. It is clear that this is more noticeable in small cities, towns, or counties than in large metropolitan areas. On the other hand, in a particular kind of environment, such as Houston, growth in both quantity and quality is also apparent if the immediate vicinity of a center is examined separately. Furthermore, the same elements that have been detected before with regard to scientific complexes in other cities, such as growth of graduate and higher education facilities, are noticeable in connection with NASA centers and other facilities in the South. In each of the areas--with the possible exception of New Orleans, where it may not be possible to detect such changes--NASA has contributed to those elements that constitute the ingredients for economic growth. It has upgraded the skills of the labor force, upgraded the level of education available to local inhabitants, decreased unemployment, and built up the store of knowledge by virtue of its scientific mission.

In summary, we find that:

1. NASA activities have had a positive and consequential influence on the localities in the South in which it has established research and development centers and production, testing, and launch facilities.

2. These influences have gone beyond those associated merely with the channeling of government funds into an area, primarily because of the research and development nature of the work.

3. R&D is different from other transfers of government funds because it requires more highly paid, highly educated workers who demand more in the way of quality of environment. This in turn affects the quality of education, for example, available to new residents of the community as well as to old ones, resulting in greater levels of achievement by all.

4. NASA and NASA-contractor personnel have contributed to this upgrading of the environment in each community in a variety of ways, from running for and being elected to local political offices to providing pressure through neighborhood and community organizations and volunteer, charitable, and religious groups. Furthermore, it was found that, in many cases, a substantial portion of the teaching staff in local grade and high schools was made up of wives of engineers and scientists on NASA projects. These women are generally well educated, often from a more cosmopolitan environment than that found in many of the NASA locations in the South, and thus able to bring to school children a broader experience and a greater appreciation for education than they would have otherwise.

5. NASA's influence is also felt because of radical changes in per capita income that it brings about. Recent scholarly studies have indicated that the South must upgrade the productivity of its workers to achieve a position of economic (and social) health and well-being equivalent to that of the rest of the United States. Per capita income is the most reliable measure available to judge such progress, and this indicator has been affected greatly by NASA presence.

6. In certain cases, NASA has been a catalyst in stimulating other developments, particularly in New Orleans. In this case, the local economy was in a slump before the advent of space activities in the area. Uniform agreement was found among local business leaders, Chamber of Commerce officials, and others that the NASA presence was a critical influence in enlightening the community to new and progressive business opportunities.

7. The influence of NASA on education in the South is pertinent, above and beyond that mentioned above. In insisting on good educational facilities for their sons and daughters (and for themselves through college extension and graduate programs), NASA and NASA-contractor employees have laid the groundwork for a higher quality educational environment for all of the people in the communities where they reside. The South particularly needs such influences to enhance its own development.

INTRODUCTION

When one begins to review the literature concerning the relationship of research and development to economic growth, it is tempting to believe that the subject has been studied very thoroughly, because of the volume of books, reports, papers, and popular speeches that are now available.

A more objective view is gained, however, as the subject is examined in more detail. One discovers that there is still much confusion (or at least little solid ground) concerning such a relationship, if one exists, and even less evidence of either theory or data to support the hypothesis that such a relationship does exist. As one of the most current writings on this subject expresses it: "Technological advance has generally mystified layman and economist alike. In the popular literature, technological advance tends to be viewed as the result of the insight of a hero inventor. . . ." while, "In most of the (professional) literature on economic growth, technological advance tended to float in the air as a factor which increased the productivity of capital and labor, its contribution being estimated sometimes by the residual in the growth rate. . . sometimes by a time trend in productivity."(13)*

These matters will be dealt with in some detail in this report. It is necessary initially, however, to specify the scope of the present study and its relationship to more academic discussions such as the one just quoted.

As indicated in the Foreword, the present study was undertaken as a part of a brief investigation of some significant impacts of the national space program. As such, it specifically addresses consequences that have taken place in the last 10 years as a result of R&D expenditures by the National Aeronautics and Space Administration, to the extent that these consequences can be isolated from other influences such as defense R&D. Furthermore, the study addresses only a subset of those impacts, namely those that are primarily economic (and social) in nature.

Since 1958 when NASA came into existence, innumerable developments have taken place as a result of the space effort, in addition to the main thrust of establishing space technology. Among these added developments has been the changing picture of certain areas in the southern part of the United States, particularly Huntsville, Alabama; Brevard County,

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* Numbers in parentheses refer to references listed at the end of the report.

Florida; New Orleans, Louisiana; Hancock County, Mississippi; and Houston, Texas.

In each of these places, NASA has either established a major center of operations where nothing existed before or expanded considerably on a previous installation, formerly used for other purposes. These developments have changed the landscape in each of the five locations. They have affected the people as well. Manpower, work habits, and education have changed and schools, churches, recreation facilities, shopping centers, industry, and incomes have all been affected. Much of this has been reported previously, and a certain portion of this study has been devoted to bringing together past work on the subject. A more fundamental requirement, however, has been to bring to the analysis considerations of wider scope, such as the contribution of technology to economic growth on a national as well as a regional scale.

For this reason, the report begins with a brief discussion of technology and economic growth as it is presented in current economic literature. Some of the components of economic growth are thus isolated, such as improvement in education, advance of knowledge, and increases in the productivity of capital and labor in other ways, e.g., lower unemployment and higher skills of the labor force.

In the chapters that follow, an analysis is made of the contribution of NASA to these various economic growth components in the vicinity of each of the NASA centers and facilities in the South. Indicators such as per capita income are used to show large direct economic changes that have taken place in certain of the communities. Also, emphasis is placed on indirect NASA contributions, such as improvements in education, which in turn (as shown in the chapter following this one) lead to further economic growth in time.

The emphasis in this study has been on empirical evidence to support the contention that investment in research and development--even for products not directly related to consumer markets--does indeed contribute to economic growth. The economic and social impacts that are documented, therefore, are real and important, especially to the individual communities where the impacts have taken place.

More work along these lines is needed, to document more fully the extent of many impacts that are only indicated here. Such a program is suggested in the last chapter of the report.

TECHNOLOGY AND ECONOMIC GROWTH

Within the past several years, a new and important shift has taken place in the literature of economics concerned with technology and economic growth. This trend is particularly noticeable in publications of the last two years, giving a clear indication of its currentness. This new thought may be expressed perhaps as a clear acceptance of the fact that it is new technology rather than the traditional factors of production, labor and capital that has the greatest effect on the rate of economic growth.

Although this has been sensed many times before and accounted for in some ways, the relationship between technology and growth has had little serious study by economists until recently. The reasons for this are varied, but perhaps most importantly, other things had greater priority. As Schmookler explains it: "While economic development was an issue in Adam Smith's time and has become one in our own, in the interim the problems of the day concerned the tariff, monopoly, trade unions, business cycles, monetary and fiscal policy, and so on, and it was during this period and to solve these problems that the present formal apparatus of economic theory was developed."(14)

From this state of affairs, Schmookler continues, economists inherited a theory in which technological progress is assumed to be determined by noneconomic forces. Economic growth takes place simply by the accumulation of more physical capital (that is, physical plant and equipment) per worker, leading to greater output per worker and thus economic growth. All this "was, unfortunately, also wrong. For, as intimated above and as several independent studies in the last dozen years have shown, the accumulation of intellectual capital--reflected in the production of better products and the use of better methods--has been much more important than the accumulation of physical capital in explaining the rise of output per worker in advanced countries when the period studied covers several decades."(14)

What this new revelation has meant to economics is illustrated by the much greater current interest in examining the growth of an economic system as opposed to its inner workings. This report contains a brief bibliography of some of the important recent contributions to technology and growth, and this chapter is an attempt to bring portions of the work to bear on the question "What is NASA's contribution?"

Theoretical Studies

The theory of economic growth that was passed down to modern scholars has been characterized as consisting primarily of production functions relating inputs of capital and labor to the "output" of gross national product. According to Zimmerman (19) the Cobb-Douglas function became the favorite. This function in its specific form, "assumed that a 1 percent increase in the labor force would increase production by 3/4 of one percent, and a 1 percent increase in capital would increase production by 1/4 of one percent."

The difficulty came with empirical evidence. Douglas himself, again according to Zimmerman, "eliminated progress or dynamic improvement in the quality of capital, labor, and the industrial arts. . ." and the function thus was not complete. In fact, as data over long periods of time began to be studied, it became obvious that a contribution of the rate of growth at least as large if not larger than the contribution of capital and labor was being made by improvements in those factors. This increment came to be called by various names, such as technological improvement, technical progress, and the residual factor in the theory of economic growth.

As many recent writers have observed and as indicated above, the close examination of these theories and the gathering of data to determine the relevance and importance of its various inputs, including the residual, did not begin until the last decade or so. One of the first writers on the subject was Edward F. Denison. His study, "The Sources of Economic Growth in the United States and the Alternatives Before Us,"(3) has now become somewhat of a classic, because it isolated seven separate factors in addition to capital and labor as contributing to the rate of growth of U.S. gross national product from 1909-29 and from 1929-57 and evaluated the contribution of each. In addition, Denison adjusted the contribution of labor to account for changes in its quality by itemizing separately the increase (or decrease) resulting from shorter working hours, increased education, increased experience and better utilization of women workers, and changes in age-sex composition of the labor force.

To illustrate some of his results, Table 1 is reproduced from Denison's study. This table shows that, using Denison's method, 68 percent of the rate of growth of real national income (GNP adjusted for changes in the price level) was accounted for by changes in the inputs of capital and labor in the period 1929-57. The remaining 32 percent, the residual factor, was allocated to restrictions against optimum use of resources (-2 percent), reduced waste of labor in agriculture (1 percent), industry shift from agriculture (2 percent), advance of knowledge (20 percent), and economies of scale represented by growth of local and national markets (11 percent). Breaking down the contribution of labor into its component parts, Denison reasoned that changes in employment and hours contributed 27 percent to the growth rate, improvements in education contributed 23 percent, and increased experience and better utilization of women workers contributed 4 percent.

Table 1

ALLOCATION OF GROWTH RATE OF TOTAL REAL NATIONAL INCOME AMONG THE SOURCES OF GROWTH

	Percentage Points in Growth Rate		Percent of Growth Rate	
	1929-57	1960-80*	1929-57	1960-80*
Real national income	2.93	3.33	100	100
Increase in total inputs	2.00	2.19	68	66
Labor, adjusted for quality change	1.57	1.70	54	51
Employment and hours	.80	.98	27	29
Education	.67	.64	23	19
Increased experience and better utilization of women workers	.11	.09	4	3
Changes in age-sex composition of labor force	-.01	-.01	0	0
Land	.00	.00	0	0
Capital	.43	.49	15	15
Nonfarm residential structures	.05	n.a.	2	n.a.
Other structures and equipment	.28	n.a.	10	n.a.
Inventories	.08	n.a.	3	n.a.
U.S.-owned assets abroad	.02	n.a.	1	n.a.
Foreign assets in U.S.	.00	n.a.	0	n.a.
Increase in output per unit of input	.93	1.14	32	34
Restrictions against optimum use of resources	-.07	.00	-2	0
Reduced waste of labor in agriculture	.02	.02	1	1
Industry shift from agriculture	.05	.01	2	0
Advance of knowledge	.58	.75	20	23
Change in lag in application of knowledge	.01	.03	0	1
Economies of scale-independent growth of local markets	.07	.05	2	2
Economies of scale-growth of national market	.27	.28	9	8

n.a. = not available.

* Growth rate based on high-employment projection.

Source: Reference 3, p. 266.

Of all of these parts, the most apparently relevant to NASA is the contribution to the advance of knowledge. However, as Denison describes in detail, this increase (1) is impossible to measure by any statistics that are available, including patents or research and development funds, and (2) however it is measured it would not include advances of knowledge that contribute to the introduction of new or better final products or cheaper final products if they differ in physical characteristics from the old. The reason for these exclusions is that Denison is analyzing "measured" rather than "true" GNP growth. "It is conceivable," he says, "that these omitted benefits of greater knowledge make a greater contribution to the advance of individual welfare than those that are measured; it is certain that they make a greater contribution to national defense. These benefits cannot be measured with information now available. But neither can they be ignored in considering possible ways of influencing the growth of the 'true' national product."

For Denison, therefore, and for many others since Denison, the advance of (technological) knowledge relates primarily to patentable inventions, "and to the host of improvements that would be patentable except that they represent too small an advance in the state of the arts, or are deemed too obvious, to qualify."* He then indicates that neither defense nor space R&D expenditures contribute very much to such improvements, principally since their products are used by the government, not consumers.

All of this is somewhat difficult to accept when it appears intuitively that the nation depends to such a large extent on products (such as computers) and "processes" (such as air transportation) that gained their initial impetus under government sponsorship. The problem is, as Denison points out, with measured as opposed to true growth. Although this study has not itself uncovered (or developed) a better means for evaluating technology and growth, it is essential to know why government R&D tends not to appear in the growth rate and to be alert to the possibility that its contribution is understated.

In considering these points, it is apparent that the major identifiable contribution to both regional and national economic growth may be indirect. Again and again, NASA (and defense) R&D appears as a catalyst in stimulating quality improvements in education; bringing about increases in per capita income; stimulating the development of new R&D companies in some cases; providing an "environment for growth," such as in Huntsville and New Orleans; and again in some cases, providing the essential R&D for products and processes that have commercial value. It can be argued that more efficient means may be available for accomplishing many of these ends. On the other hand, it would be a mistake to ignore NASA's (and DoD's) contribution in these areas.

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* Denison also includes in advance of knowledge, managerial knowledge, which "consists of advances in knowledge concerning the techniques of management, construed in the broadest sense, and in business organization (3), p. 232.

Furthermore, it is again relevant to point out the deficiencies in available data when attempting to evaluate any relationship between R&D and growth, "true," "measured" or otherwise. "Although information on long-term trends in gross national product dates back to 1870, meaningful data on research and development outlays have been compiled by the National Science Foundation only since 1953."(17) These data are not completely relevant to the analysis even when they are collected. Patent statistics are similarly unsatisfactory, as recognized even by those using them in economic research.*

For all these reasons it may be impossible for some time to point to clearly identifiable and acceptable time trend statistics with which to develop a satisfactory relationship between research and development and economic growth. In another context--relating to cost plus contracting and its possible effect on the allocation of resources for invention--C. J. Hitch has remarked: "What is badly needed here is an economics invention or, more probably, several of them. . . ."† It seems clear that such is the case here, despite the continued attention to the subject indicated above and by the bibliography to this report.

Relationship to Present Study

The above discussion indicated briefly that, with present economic techniques and models, the major contributions of NASA to economic growth that can be identified may be indirect. These impacts may be summarized as those that effect improvements in human capital.(1,2,15)

In essence, these improvements amount to any and all changes which take place in the direction of improving the productivity of labor. Becker points out (1) that investments in human capital may take many forms, such as schooling, on-the-job training, medical care, migration, and searching for information about prices and incomes. Furthermore, he stresses the "accumulation of a tremendous amount of circumstantial evidence testifying to the economic importance of human capital, especially of education. Probably the most impressive piece of evidence is that more highly educated and skilled people almost always tend to earn more than others."

In the NASA case this is especially true. Average salaries for NASA and NASA-contractors are considerably higher than average, around $10,000 annually at most centers and facility locations. Average educational level is of course also higher, by virtue of the fact that the entire

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* See, for example, Schmookler (14), pp. 18-24. Also, Simon Kuznets, "Inventive Activity: Problems of Definition and Measurement," in The Rate and Direction of Inventive Activity.(12)

† Charles J. Hitch, in a comment on a paper by Kenneth J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," in The Rate and Direction of Inventive Activity (12), p. 626.

organization is devoted to research and development, requiring a more highly educated and skilled work force.

The present study, in the following chapters, thus examines the impact of NASA on the localities in the South where it has established facilities, in an attempt to determine, in the absence of clear, statistical series, at least further evidence of a relation between technology and economic growth based upon these indirect effects of improvements in human capital. After a brief introductory chapter, each of the localities is examined in more detail, as the evidence for such impacts emerges.

HISTORICAL PERSPECTIVE

The background against which the empirical portion of the study was conducted is the economic and social structure of the South in the last 10 years, that is, during the time of the existence of NASA. This period has been a time of expanding capabilities and greater use of resources of the South, including its Negro manpower. Much remains to be done, however, to broaden the base of these improvements, as illustrated by the fact that, in 1966, per capita income in the South was less than 75 percent of that in the remainder of the United States.(10) (See Table 2.) This is no surprise to most well-informed people, and it is necessary to recognize differences in living expenses in the South compared with those of other regions to put such comparisons as per capita income into better perspective. Such differences are of current and widespread interest, as a result of increasing emphasis on finding new means to improve the welfare of all of the nation's people.*

The South as a Region

For many years, the South has lagged behind the rest of the United States in almost every indicator of social and economic development. Recent studies have illustrated conclusively the stark differences between the South and the rest of the United States that have prevented the two areas from enjoying similar degrees of prosperity. Far from being critical over this situation, however, these recent studies have been presented with an extraordinarily positive approach, as befits the radical changes that are taking place in the South toward correcting past imbalances.

As pointed out in one of the most recent of these studies (11), "The South is in a period of great transition. It is closing the door on one period of history and entering another. The changes it is experiencing are numerous and complex."

Among these changes is a shift from a dominant agrarian economy to a greater emphasis on manufacturing, commerce, trade, and services. Accompanying these changes is a movement from rural to urban areas. Race relations are changing, affecting the entire structure of the South.

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* The Monthly Labor Review for March 1968, for example, was devoted in its entirety to the subject "Labor in the South." It also included as one of its major articles a condensation of the NASA-funded report "Economic Impact of the Manned Space Flight Program" by Mary Holman and Ronald Konkel.(7)

Table 2

PER CAPITA PERSONAL INCOME IN THE TOTAL UNITED STATES, THE SOUTH, AND THE REMAINDER OF THE UNITED STATES
1940-66

Year	Per Capita Personal Income			South as a Percentage of the Remainder of the United States
	United States	South*	Remainder of the United States	
1940	$ 595	$ 357	$ 688	52%
1941	719	447	827	54
1942	909	607	1,031	59
1943	1,102	759	1,242	61
1944	1,194	861	1,329	65
1945	1,234	895	1,368	65
1946	1,249	884	1,391	64
1947	1,316	929	1,464	63
1948	1,430	1,027	1,582	65
1949	1,384	1,023	1,520	67
1950	1,496	1,087	1,652	66
1951	1,652	1,209	1,823	66
1952	1,733	1,284	1,905	67
1953	1,804	1,339	1,979	68
1954	1,785	1,336	1,951	68
1955	1,876	1,416	2,047	69
1956	1,975	1,493	2,154	69
1957	2,045	1,539	2,235	69
1958	2,068	1,585	2,249	70
1959	2,161	1,660	2,348	71
1960	2,215	1,685	2,414	70
1961	2,264	1,740	2,461	71
1962	2,368	1,814	2,578	70
1963	2,455	1,899	2,665	71
1964	2,586	2,015	2,803	72
1965	2,760	2,164	2,987	72
1966	2,963	2,345	3,201	73

* In this table, the South includes the following states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

Source: Reference 10, p. 91.

Educational opportunities are expanding continuously, and, again as the referenced study points out, even the political structure is changing.(11)

All of these factors bear on the impact of the recent appearance on the southern scene of NASA. It will be seen that NASA's influence has taken a particular form in the South because (1) NASA is a research and development agency and thus a high technology activity (as contrasted with other forms of government expenditure such as a military base); (2) the tradition of the South has left many areas less advanced technologically than other areas of the country; and (3) the combination of these two elements has had far-reaching consequences and influences in terms of depth, if not in terms of geography.

One of the most important of these influences is NASA's impact on education. Statistics included in later sections of this report indicate very large increases in enrollment in both primary and secondary schools around certain NASA locations in the South, as well as large increases in college enrollment in more restricted areas. These changes have taken place, of course, as a direct result of the increases in population (also identified later in the report) that were necessitated by the establishment of the NASA activities. What is not so easily recognized is that the quality of the education has been substantially affected, so much so that in one of the NASA locations the phenomenon was documented as far back as 1964.(17) Furthermore, requirements for services to meet the demands of more highly educated people necessarily have stimulated the desires of local (and many times long-established) residents for more and better services for themselves.

The NASA Manned Space Flight Communities

Within the South as a region, individual counties and communities have experienced radically different economic patterns also. To illustrate this fact, it is only necessary to consider Alabama, which in 1960 had a range of median family incomes from rank 5 to rank 2,552 among all counties in the nation.(4) It is significant that the county with the highest median income at that time was Madison County where Huntsville and NASA's Marshall Space Flight Center are located.

It is not the intention of this report to delve in detail into the direct economic impacts on the several "NASA communities" in the South, since this has already been done, particularly in Reference 7. However, some reiteration is necessary. Figures 1 through 4 illustrate briefly the changes that have taken place in the five NASA locations since 1950. For example, the population of Brevard County, Florida, was approximately 24,000 in 1950 and 224,000 in 1965, for almost a ten-fold increase in 15 years. The increase in the first 10 years of this period was a result of Department of Defense's reactivation of the Banana River Naval Air Station (now Patrick Air Force Base). Since 1960, the increase has resulted primarily from NASA's John F. Kennedy Space Center. Similarly, in Huntsville, Alabama, population increased from 16,400 in 1950 to

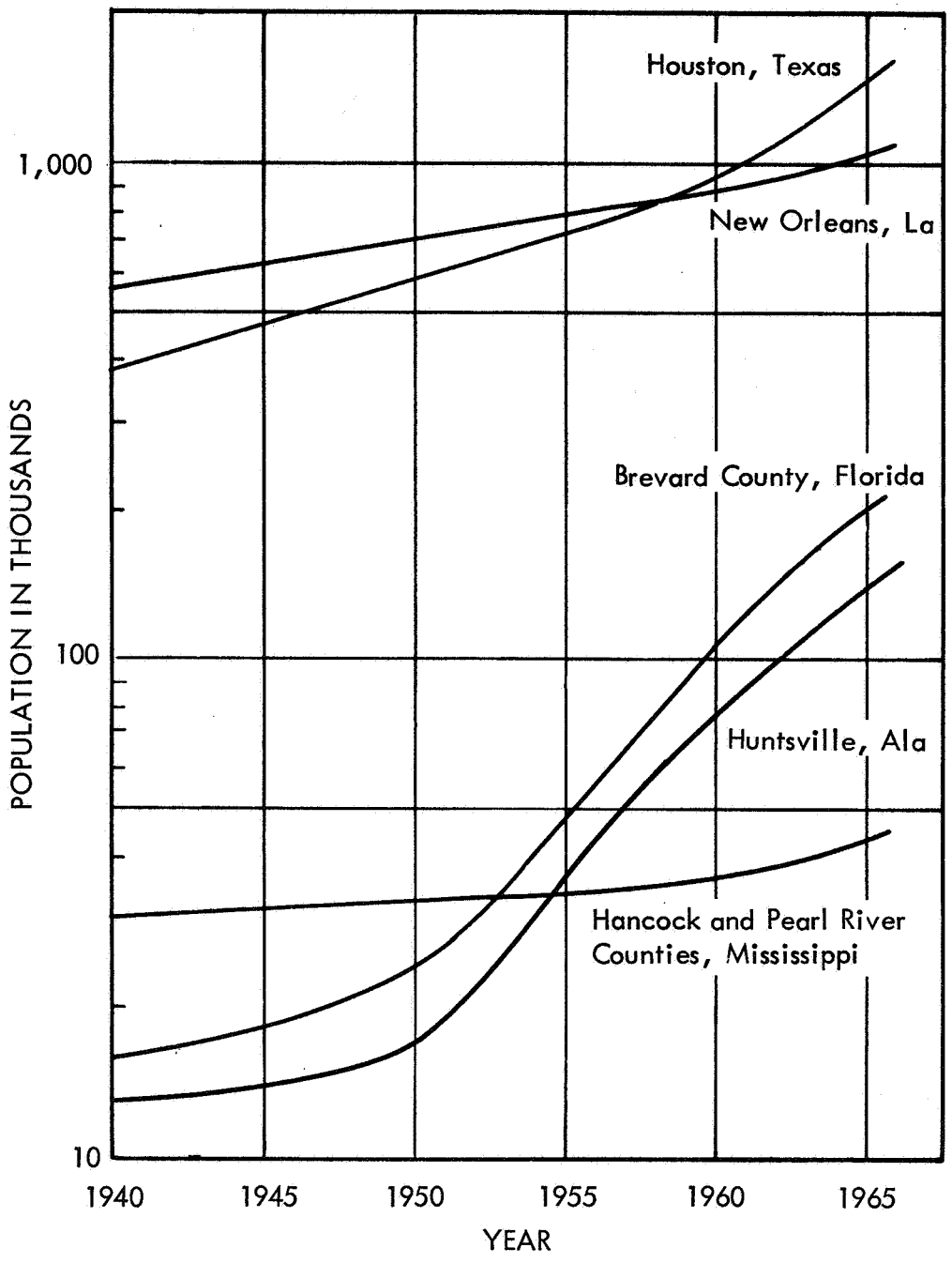

FIG. 1 POPULATION CHANGES IN NASA MANNED SPACE FLIGHT COMMUNITIES, 1940-1966

SOURCE: M.E. Holman and R.M. Konkel, "Economic Impact of the Manned Space Flight Program, " (Ref. 7)

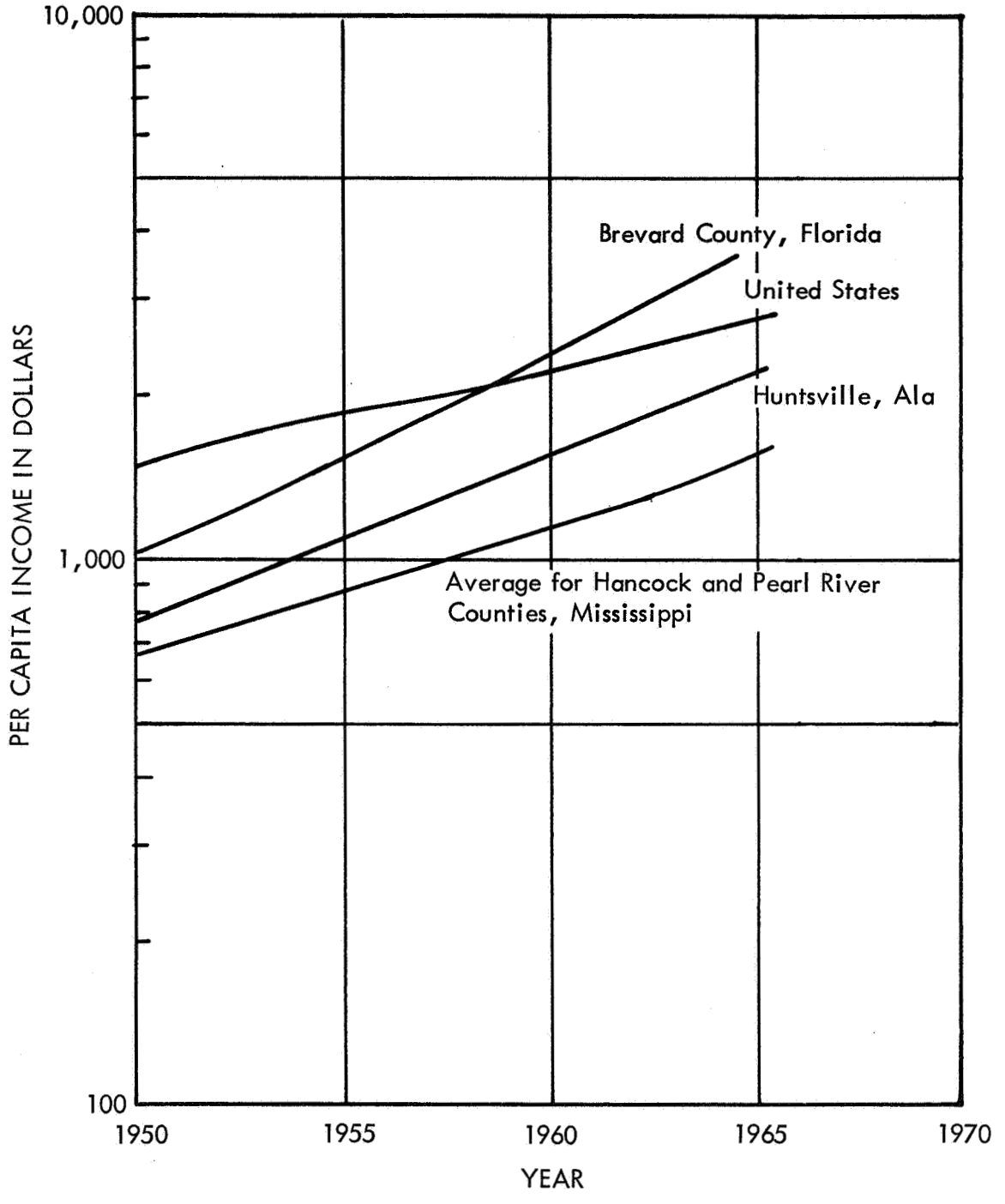

FIG. 2 CHANGES IN PER CAPITA INCOME, NASA MANNED SPACE FLIGHT COMMUNITIES, 1950-1966

SOURCE: M.E. Holman and R.M. Konkel, "Economic Impact of the Manned Space Flight Program, " (Ref. 7)

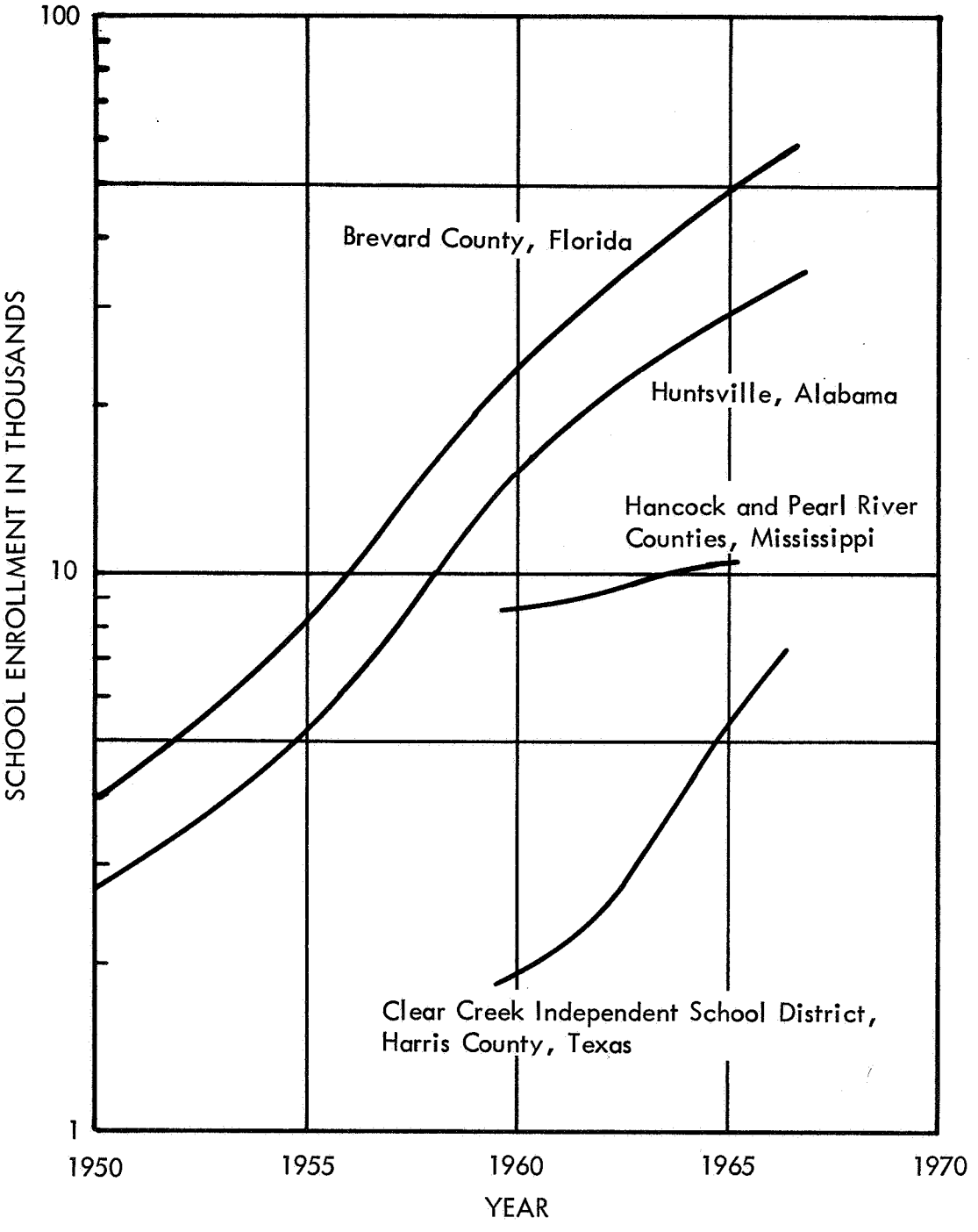

FIG. 3 INCREASES IN SCHOOL ENROLLMENT, NASA MANNED SPACE FLIGHT COMMUNITIES, 1950-1966

SOURCE: M.E. Holman and R.M. Konkel, "Economic Impact of the Manned Space Flight Program, " (Ref. 7)

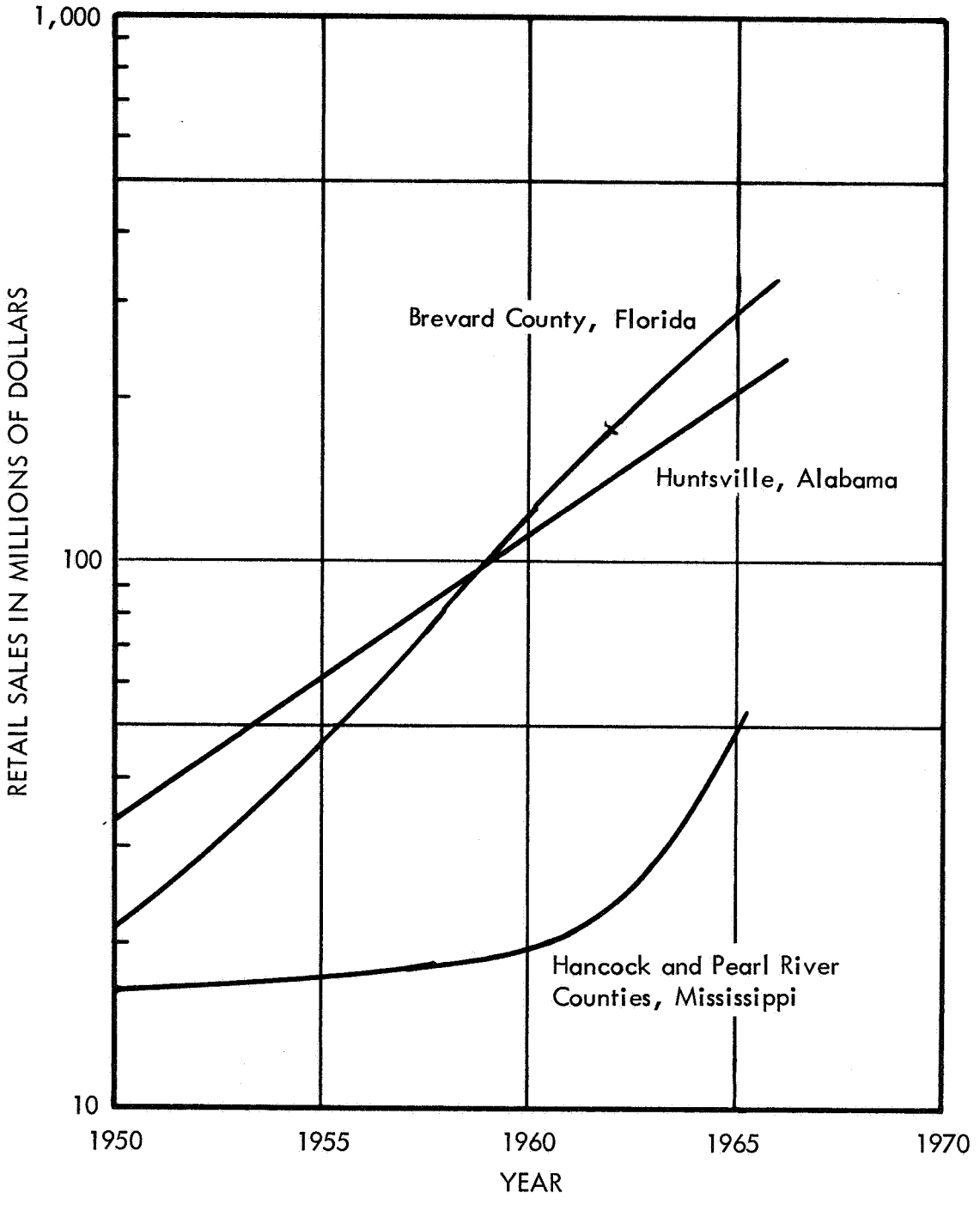

FIG. 4 INCREASES IN RETAIL SALES, NASA MANNED SPACE FLIGHT COMMUNITIES, 1950-1966

SOURCE: M.E. Holman and R.M. Konkel, "Economic Impact of the Manned Space Flight Program, " (Ref. 7)

143,700 in 1965, again from an increase in DoD employment in the 1950s at the Army's Redstone Arsenal and from an increase in NASA employment in the 1960's at MSFC. Accompanying these rapid build-ups, were increases in school enrollment, building permits, retail sales, bank deposits, and other indicators of direct economic consequence.

As shown in Figures 1-4, analogous growth patterns applied to Hancock and Pearl River Counties in Mississippi, where NASA's Mississippi Test Facility is located. There, while total employment grew by about 5,000 from 1960-66, NASA employment grew by 4,740. Thus, the impact of the new NASA installation on local communities was very great, particularly Picayune in Pearl River County.

In contrast to the extensive direct and clearly identifiable impact of NASA activities on Huntsville, Brevard County, and Hancock and Pearl River Counties, NASA's direct impact on New Orleans and Houston, was considerably less. As pointed out in "Manned Space Flight and Employment,"(8) the effect on New Orleans has been considerably greater than that on Houston as a result of different growth patterns in the two cities. Houston, for example, had for many years before the advent of the space program been one of the fastest growing, most dynamic centers of population in the nation. New Orleans, on the other hand, had been somewhat more sluggish in its response to new growth prospects.

As measured by employment, the economy of New Orleans had been in a slump for nearly five years before the reopening of the Michoud Facility. Unlike the rest of the nation, which had recovered from the 1957-58 recession by 1959, total employment in New Orleans did not regain its 1957 peak of about 292,000 until 1963. Between 1957 and 1961, the unemployment rate in New Orleans rose steadily from 2.7 to 6.2 percent.(8)

This trend was distinctly reversed from 1961-66, during which time New Orleans, among the 30 largest metropolitan areas in the nation, became one of the 10 fastest growing areas in terms of employment growth.(8) A considerable portion of this was attributable to the reopening of the Michoud Assembly Facility, since it generated 11,000 new jobs out of a total of about 50,000 for the New Orleans area.

Underlying all of these statistics, however, is a continuing question; that is, (whether growth is small or large, taking place in a small population center or an already large one) is growth generated by a government-funded research and development activity any different from growth generated by the establishment of a military base or a large industrial plant?

To answer this question, it is necessary to probe further into what have been called social impacts, but that are really economic ones as well. These are discussed in the next chapter.

IDENTIFIABLE NASA CONTRIBUTIONS

The impact on certain of the communities in which NASA operates in the South has been extensive. In three of these areas, the economic impact has been direct and substantial; in the other two areas, local economies have been affected only slightly, but the catalytic effect of the space program has stimulated businessmen and community leaders to think in even broader terms of expansion and utilization of local resources than they had before.

Much of this change might reasonably be attributed to an influx of, and an enthusiasm for, funds from the federal government--whatever their specific source and whatever their end use or purpose. On the other hand, it appeared during this study that there was something distinct about the infusion into a community of federal funds for research and development, as opposed to federal funds for other uses.

To investigate this hypothesis, the principal investigator in this study visited each of the NASA centers or bases of operations in the South. This chapter describes the results of those visits and discussions, together with background material drawn from previous studies along similar lines.

Huntsville, Alabama

In 1964, a Select Committee of the U.S. House of Representatives, 88th Congress, performed a study entitled, "Impact of Federal Research and Development Programs."(17) In this investigation, impacts on communities, higher education, industry, and the economy and the nation generally were examined. The study revealed, in part, that:

1. Federal research and development programs make their impact on a given area in one or more of three ways: The federally owned or operated research and development installation; the research and development contract. . .; and the expenditure of basic research funds . . . in institutions of higher learning.

2. Regardless of the channel, if significant numbers of Federal research and development activities, projects or dollars are involved, there is often a special impact on the locale, seemingly distinct from the spending of Federal dollars in other types of activities, which impact is especially noticeable in small cities.

3. Aspects of this impact include, on the one hand, the phenomenon of university and especially of graduate program expansion

following upon the location of a Federal research and development installation in a community; and, on the other hand, in a particular climate, the occasional phenomenon of certain types of research and development related industries growing up around those universities which are heavily endowed with Federal research and development grants and contracts.

4. One apparently consistent characteristic of Federal research and development activity, and especially any activity which involves significant numbers of scientists and other professional personnel, is that primary and secondary school systems are upgraded, often markedly. The select committee found striking examples of this in Huntsville, Alabama, and Tullahoma, Tennessee, where major Federal research and development installations are located; Stanford Research Institute found similar evidence of favorable changes in other communities.

These results of several years ago were substantiated in the present study. For example, discussions with members of the Executive Staff at Marshall Space Flight Center confirmed each of the findings of the select committee with regard to Huntsville, especially as to improvements in the school system, the active role played by the center in the establishment and continuity of the Research Institute, the establishment of an impressive research and industrial park, and the establishment and expansion of a branch of the University of Alabama at Huntsville.

Since these facts are important to the present discussion, it is appropriate to reiterate them here. First, the select committee found that educational facilities in Huntsville had been improved radically from 1950 to 1964:

> Total enrollment in primary and secondary schools increased from 3,138 in 1950 to 27,537 in 1964, with a consequent burden on local budgets. In 1956, Huntsville voters overwhelmingly approved an increase in ad valorem taxes, boosting the total tax rate (including city, county, and State levies) to $4.10 per $100. Revenues realized from this additional levy were earmarked for school construction programs.
>
> Since 1955 school construction in the Huntsville area has increased at the rate of approximately one new classroom a week. The number of public schools increased from 8 in 1956 to 28 in 1964, representing more than 800 classrooms. Because of the steady growth of facilities the community has not been forced to resort to double sessions at any time.
>
> Whereas in 1950 the figure for median school years completed by Huntsville residents 25 and older was well below the national average (7.5 years as against 9.3 years), by 1960 the Huntsville average was 0.2 years above the then national average of 10.6 years. Results of testing programs for students in grades

1 through 12, showed that Huntsville students compared quite favorably with those in other States using similar tests. A majority of the scores are consistently in the upper 25 percentile. Comparable results show up on tests of the American College Testing program, the National Merit Scholarship program, and the college entrance examination program. Between 75 and 80 percent of all Huntsville secondary school graduates now enter college.

Some 350 spouses of Redstone personnel or of the local defense-related industry serve as teachers in the Huntsville system. Substantial salary increases in recent years, coupled with an actual decrease in student-teacher ratios contribute to the attractiveness of teaching opportunities. Of the more than 800 teachers in the city school system, approximately one-fourth hold master's degrees, a high percentage compared with other Alabama cities.

Significant improvements in curriculum content have been made since the initial influx of NASA and Missile Command personnel. Such courses as advanced biology and calculus have been added to the secondary school program.

The school system of Madison County (in which Huntsville is situated) consists of 30 schools with an enrollment of 12,860 students, about 1,500 of them "federally connected." Three private academies and two parochial schools serve an additional 1,800 students. An extension unit of the State vocational technical school was recently established at Huntsville, offering high school students the opportunity to complete the 11th and 12th grades with training in electronics, auto mechanics, and related technical fields. The effect of this new program has been to up-grade substantially the labor force for the entire area, and many of the graduates of the technical school find ready employment at the Redstone Arsenal.

The Huntsville Center of the University of Alabama and the university's Research Institute developed concurrently with the growth of the Redstone complex, largely as a result of concerted community effort. The university center has attracted an enrollment of more than 4,000 students. Of this number, 1,515 are estimated by Huntsville's superintendent of public schools to be dependents of Federal employees at Redstone and of those of related industries. The Center's drive toward expansion has been greatly accelerated since 1959 by the mushrooming demands placed upon it by scientific personnel in the area. The university allocated $250,000, matched by similar appropriations from both the city and Madison County, for a total of $750,000. In addition, the city and county donated 355 acres of land for the campus, and the county contributed the building of all necessary roads.

The university center presently houses the largest graduate engineering school in the South. A further expansion of the center is currently underway, and another $750,000 is being raised to finance a new undergraduate program, first instituted in September 1964. Projected figures indicate that more than 6,000 students will be enrolled at the university center by 1966 in both graduate and undergraduate programs. This compares with a total enrollment of 1,500 in degree-granting institutions in the Huntsville area prior to 1958.

The Research Institute, founded in 1960, is adjacent to the university center, and with Research Park, constitutes the complex of research facilities bordering the arsenal. Many of the institute's staff participate as professors in the resident master's degree program offered by the university center, while the latter supplies the institute with graduate and undergraduate students who wish to participate in particular research projects. The institute is served by more than 200 full-time academic, research, and technical service personnel.

Second, the committee discussed the establishment of an R&D industry in Huntsville:

The Huntsville Industrial Expansion Committee, organized in the early forties, had long realized the vast opportunities which the Redstone Arsenal complex, in close proximity to the heart of the city on the one side and large, unused tracts of land, on the other, presented. Efforts to attract industry and educational institutions into the Huntsville area were intensified in the late 1950's and were centered around the two major projects. The expansion committee played an important role in raising funds for the establishment of the Research Institute, a branch of the University of Alabama created to provide research in the aerospace physical sciences. Dr. von Braun, shortly after being appointed Director of the Marshall Space Flight Center, helped by making an eloquent appeal before the Alabama State Legislature for funds to establish the institute. It was officially opened 3 months after Marshall Space Flight Center, on October 1,1960, on an interim basis with personnel loaned by main campus departments. A State bond issue provided $3 million for buildings and equipment, and an additional $400,000 was pledged by the city of Huntsville and Madison County.

A concurrent development was the creation of Industrial Research Park by a nonprofit group known as Research Sites Foundation, Inc., a land holding arm of the industrial expansion committee. This organization leases and sells properties on a 2,000-acre tract adjacent to the arsenal to private firms and research groups at attrative rates; it is pledged to donate profits from these transactions to the Research Institute.

Finally, the committee found improvements not only in the magnitude but also in the quality of Huntsville's economic base:

> Nowhere is the 10-year expansion in the Huntsville metropolitan area more apparent than in its economy. As an average of 36 new persons establish residence in the city each day, the demand for new and diversified goods and services, for residential housing and public facilities, continues to grow at a brisk rate.
>
> In the period 1950-60, Huntsville's median family income increased 226.1 percent, as against a 117.5 percent for the State and 84.2 percent for the Nation. On a per capita basis, Madison County registered a 99.1 percent increase in income over the same period, well ahead of the 68.5 percent gain for the State as a whole. Total industrial payrolls for Huntsville (including the Army and NASA) were over $250 million last year, while agricultural income from the county exceeded $25 million.
>
> During the 1950's, the total dollar retail volume in the Huntsville area more than tripled; by the end of 1964 it topped $200 million. Retail employment showed a comparable increase. Paralleling similar changes in cities throughout the country, retail establishments opened eight branch stores in shopping centers on major arteries leading into the center of the city since 1957. Merchants in downtown Huntsville, although their sales volume continues to grow each year, are trying to counter that trend; they recently formed a corporation to modernize and broaden the boundaries of the central business district. Local authorities have allotted a quarter of a million dollars for a central area study involving reconstruction, land reuse, marketing capability, and city traffic problems.

The report goes on to discuss improved as well as expanded construction activity; improved banking and capital financing facilities; the responsiveness of local authorities to the community's demand for increased public services such as street maintenance, garbage collection, fire and police protection, city planning, and engineering and traffic control; the undertaking of programs aimed at replacing public buildings, including the city hall, courthouse and public library, and the establishment of a new municipal airport, "which, when completed. . . will contain the largest air facilities in the state."*

> The problem of financing these ever-increasing expenditures, local government officials indicated, has not been overly difficult--especially since each new resident broadens the tax base and represents an additional source of municipal revenues. Still, per capita State and local taxes are the

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* Data supplied by Huntsville City Hall, according to the report of the select committee.

lowest in the Southeast and 40 percent lower than the U.S. average. In 1957, the city instituted levies on tobacco, gasoline, and gross receipts, which now represent a major source of government funds. The gross receipts taxes produce more than $1 million of the city's revenue. There is no indication that the imposition of this tax has had a negative effect on the movement of industry into the area; indeed, it is since 1957 that the greatest influx has occurred.

Since the time of this previous report (1964), many of the improvements then under way have been completed. The Huntsville Jet Port is now in operation, and bidding heavily for increased traffic, particularly connecting flights, in competition with Atlanta, Georgia. The facility is large and impressive, built for expansion in the future as required, and furnished luxuriously for a city of Huntsville's size. The Jet Port is credited with attracting nonspace related industry to Huntsville. Dunlop Tire, Pittsburgh Plate Glass, American Electric, and Barber and Coleman have established facilities near the airport, and other companies are considering such a move.

The area has been further enriched by cultural activities, such as art, ballet, little theatres, a civic opera society, a civic symphony, a chamber music guild, a community chorus, a film forum, and a fantasy playhouse for children. The Arts Council of Huntsville now has 11 member organizations and they have jointly, in addition to their individual activities, begun sponsoring an annual event, "Showcase of the Arts."

Further expansion of university and graduate educational facilities has taken place. The Huntsville campus of the University of Alabama now offers courses of instruction leading to the bachelor of science degree in physics and mathematics and to the bachelor of arts degree in English, history, and mathematics. Master's degree programs are available in mathematics; physics; chemistry; and electrical, mechanical, industrial, and aerospace engineering.

"In addition, all requirements toward the Ph.D. degree, except for a two-semester period of residence at the main campus of the University at Tuscaloosa, may be completed in several scientific and technical fields."(7)

All these indicators are important, in the context that quality and content of the environment has changed in Huntsville as well as direct economic factors. As the select committee pointed out in its study, "Huntsville's 'aristocratic face' scarcely changed from the Civil War to World War II." Since then it appears to have changed much and, according to long-time residents, for the good of the entire community.

For brevity, a summary of these impacts is given in Table 3.

Table 3

SUMMARY OF IMPACTS ON HUNTSVILLE

Direct Economic Impacts*

	1960	1965
Population	72,000	144,000
School enrollment	15,300	32,200
Public school classrooms	568	1,010
Residential building permits	1,436	5,066
Personal income per capita	$ 1,537	$ 2,054
Retail sales (thousands)	$111,300	$207,800

Other Impacts

Establishment and continuity of the Research Institute
Expansion of Huntsville Branch of the University of Alabama
Establishment and expansion of the Industrial Park
Improvement in quality of education, keeping pace with increasing numbers
Median years of school completed above national average
Large percentage of high school graduates entering college
Wives of scientists and engineers teaching in public schools
Salary increases for teachers
Improvement in public school curricula
Community support for Research Institute and University of Alabama at Huntsville
Improved county and city public facilities
Completion of new jet port facilities
Encouragement of establishment of non-space-related industry
Cultural enrichment of area

* As given in Reference 8, p. 34.

Brevard County, Florida

As indicated in the preceding chapter, Brevard County experienced, from 1950-66, one of the highest growth rates of any area of the country. This explosive growth came to an area characterized as agricultural, like most of the other areas of the South where NASA located. Furthermore, with the exception of the Air Force's Patrick Air Force Base, the area was typical of many if not all of the beach communities along the Florida coast--quite and conservative.

With the advent of NASA, of course, much of this atmosphere changed. "Satellite Motels," night life, traffic congestion, and all the other trappings of a boom town appeared. Despite such outward displays, however, communities in the immediate vicinity welcomed the arrival of space activities somewhat to varying degrees.

In general, Brevard County is a collection of what used to be small beach towns, each having characteristics of its own and each having different degrees of interest and involvement with the space program. Despite great pressures since 1950 to lessen their individualities, these communities have never chosen to combine their resources into one. Geography has been given as the reason for this reluctance. The distance from the county's northernmost center of population in Titusville to the southernmost center, Melbourne-Eau Gallie, is about 40 miles; the entire area is situated on two thin strips of land, one isolated from the other by the intercoastal waterway (called at that point the Indian River). Towns along the mainland are themselves isolated from one another as well as from the beach towns, and NASA facilities on Merritt Island provide an additional separation factor by virtue of their location.(9)

Despite these influences, the individual natures of Brevard County communities probably account as much for the failure to combine forces as does geography. Considerable attention has been given to these aspects in previous studies, particularly in a series conducted for NASA by the Institute for Social Research of Florida State University.(5,6) These studies examined, in detail, such factors as governmental organization, county and municipal government finances, the educational system in the county, administration of public utilities, intergovernmental cooperation (and problems) in providing required services to the growing population, and attitudes and abilities of newcomers to be assimilated into the communities. In all of these studies, significant differences of attitude, approach, and opinions clearly were illustrated among the communities in the county. Furthermore, unique characteristics of the governmental structures precluded full and complete cooperation toward a unified political position. As one report expressed it:

> Instead of a central city, there are four cities almost equal in population which provide a center for their particular area in the county--Titusville in the north, Cocoa in the center and Eau Gallie and Melbourne in the south. In each of these centers smaller cities have developed, in some cases almost surrounding

> the existing older cities. The result is a fragmentation of political authority among the separate cities that inhibits the coordination of functional government activities for the areas of population concentration. The multiplicity of governments providing services has resulted in an imbalance, not only between municipalities but even between county residents living in different areas of the county.(6)

The same report goes on to discuss the special districts that also contribute to the confusion of governmental authority. These districts provide such services as mosquito control, flood control, fire protection, hospitals, recreation, street lighting, airports, some roads and bridges, housing, and public instruction.

From discussions with representatives of NASA at Kennedy Space Center and persons in the local area, it appears quite clearly that these kinds of problems (and many others documented more fully elsewhere) have contributed to an inability of the Cape Kennedy area to establish long term plans for growth similar to those in Huntsville. Although many of the same elements exist, such as higher per capita incomes; more and better schools; physical facilities for serving the much expanded population; and a spirited, space-oriented atmosphere, not as much of the substantive indications of change reported in Huntsville were found to exist at Cape Kennedy.

Perhaps this is not surprising, in view of the fact that the R&D base in Florida is really neither research nor development; it is test and evaluation. As such, there may be less incentive toward permanent residence by new engineers and scientists in the area, resulting in somewhat less commitment to improvements in the community found in more (apparently) permanent locations such as Huntsville. Although such conjecture would undoubtedly require further research for verification, the indications of less involvement are clear from previous studies. This has been credited to the differences in communities already mentioned; it may also, however, be a result of the type of operation being conducted at the Cape.

The impacts discussed above are summarized in Table 4.

New Orleans and Mississippi

Michoud Assembly Facility, located about 15 miles east of downtown New Orleans, covers 896 acres and represents an investment of $185 million.(8) The entire plant is under one roof, and at the peak of its operation in 1965, it employed about 12,000 people, excluding construction workers (Figure 5). Construction activity required about 2,000 employees at its peak, late in 1964.

Table 4

SUMMARY OF IMPACTS ON BREVARD COUNTY

Direct Economic Impacts*

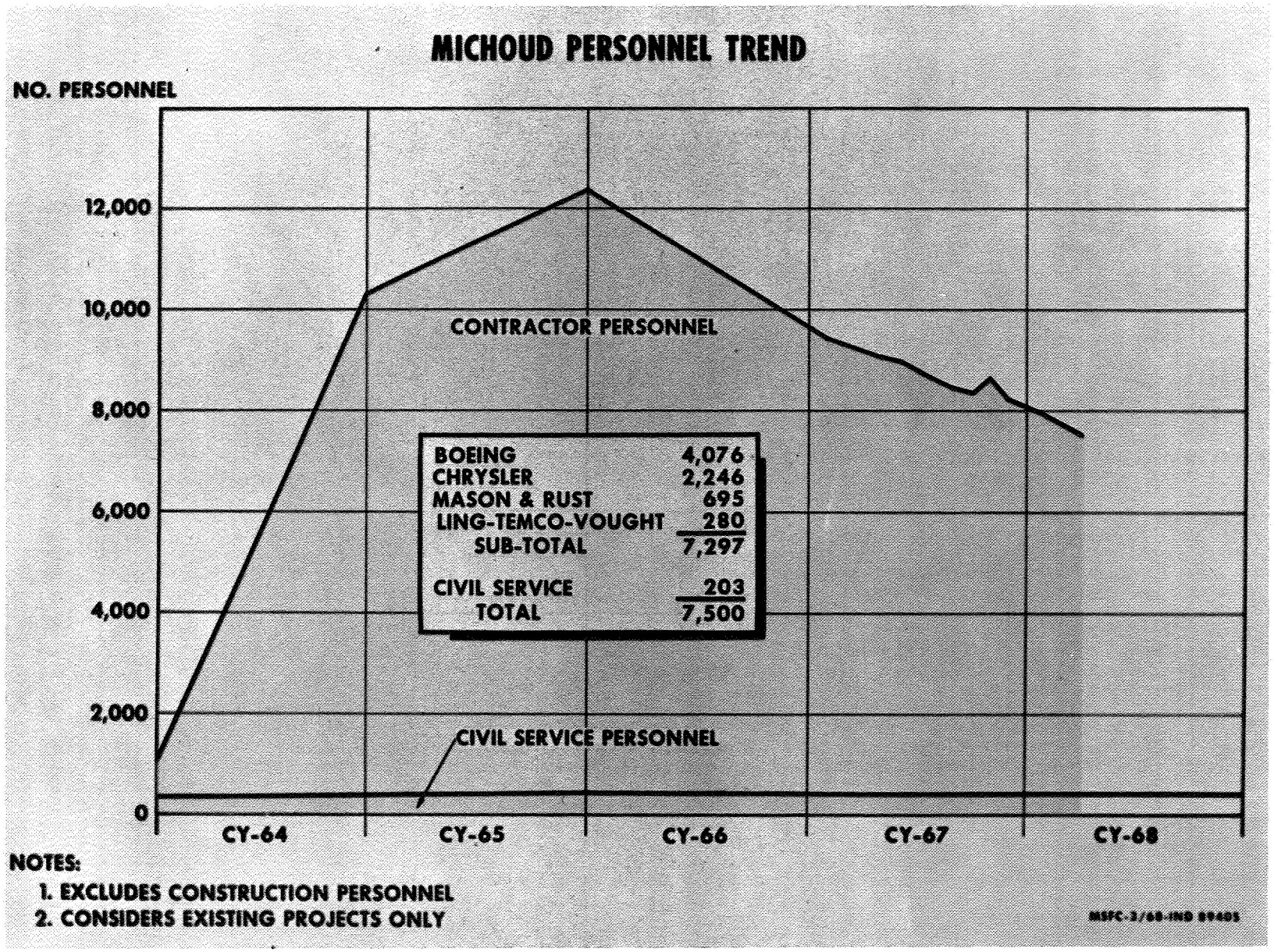
	1960	1965
Population	111,000	225,000
School enrollment	20,200	48,200
Public school classrooms	651	1,519
Residential building permits	2,614	6,933
Personal income per capita	$ 2,319	$ 3,435
Retail sales (thousands)	$125,400	$291,300

Other Impacts

Improvement in public school system
Improved public facilities
Very great community enthusiasm for expansion, indicating sharp departure from past
Highest median level of education in Florida
Highest family income in Florida

* As given in Reference 8, p. 34.

FIG. 5



SOURCE: Marshall Space Flight Center, National Aeronautics and Space Administration, Huntsville, Alabama, March 1968

As indicated earlier, the establishment of the facility came at a time when the New Orleans economy was in a slump. Thus, it had, from a practical standpoint, an identifiable bolstering effect on the economy of the area.*

By contrast, the effect on Hancock and Pearl River Counties of the Mississippi Test Facility, was enormous. Excluding construction workers, employment reached about 3,700 in 1966 (Figure 6). Including construction, MTF employment was 4,740 out of a total employment of about 5,000.(8)

As nearly as can be determined, in the case of New Orleans, the general "extra" impact (in addition to the direct economic effects) appears to be considerably more closely related to Brevard County than to Huntsville. That is, with the exception of local enthusiasm for space-related dollars, less change is noticeable on the landscape, of a permanent, "after-NASA" variety than in Huntsville.

The establishment of Michoud is given credit by many local civic leaders with having stimulated New Orleans to a greater enthusiasm for industrial growth and expansion. However, it should be noted that little enthusiasm was given to NASA newcomers to the area unless there were certain accommodations in return. For example, the presence of Chrysler was taken to be acceptable, whereas that of Boeing personnel was not. In an interview, this was explained as follows: Boeing was from Seattle, where it "runs the town." Chrysler, from Detroit, "understood" the New Orleans environment and catered to it by inviting local dignitaries to its first launches at the Cape, for example, while Boeing did not.†

It may be speculative to relate such attitudes to further developments, but the fact remains that few if any indicators of growth of quality of the environment such as noted in Huntsville are apparent in New Orleans as a result of the establishment of Michoud. Extensive and considerable dissatisfaction has been expressed with regard to the local school system. Very little new business has been attracted to the area, and no effect at all has been detected in raising per capita income of the area. Although this latter fact is relatively meaningless--since NASA employment is a small proportion of total employment in New Orleans--it nonetheless indicates that "extra" impacts are dependent on a wide variety of factors, including size of the local community.

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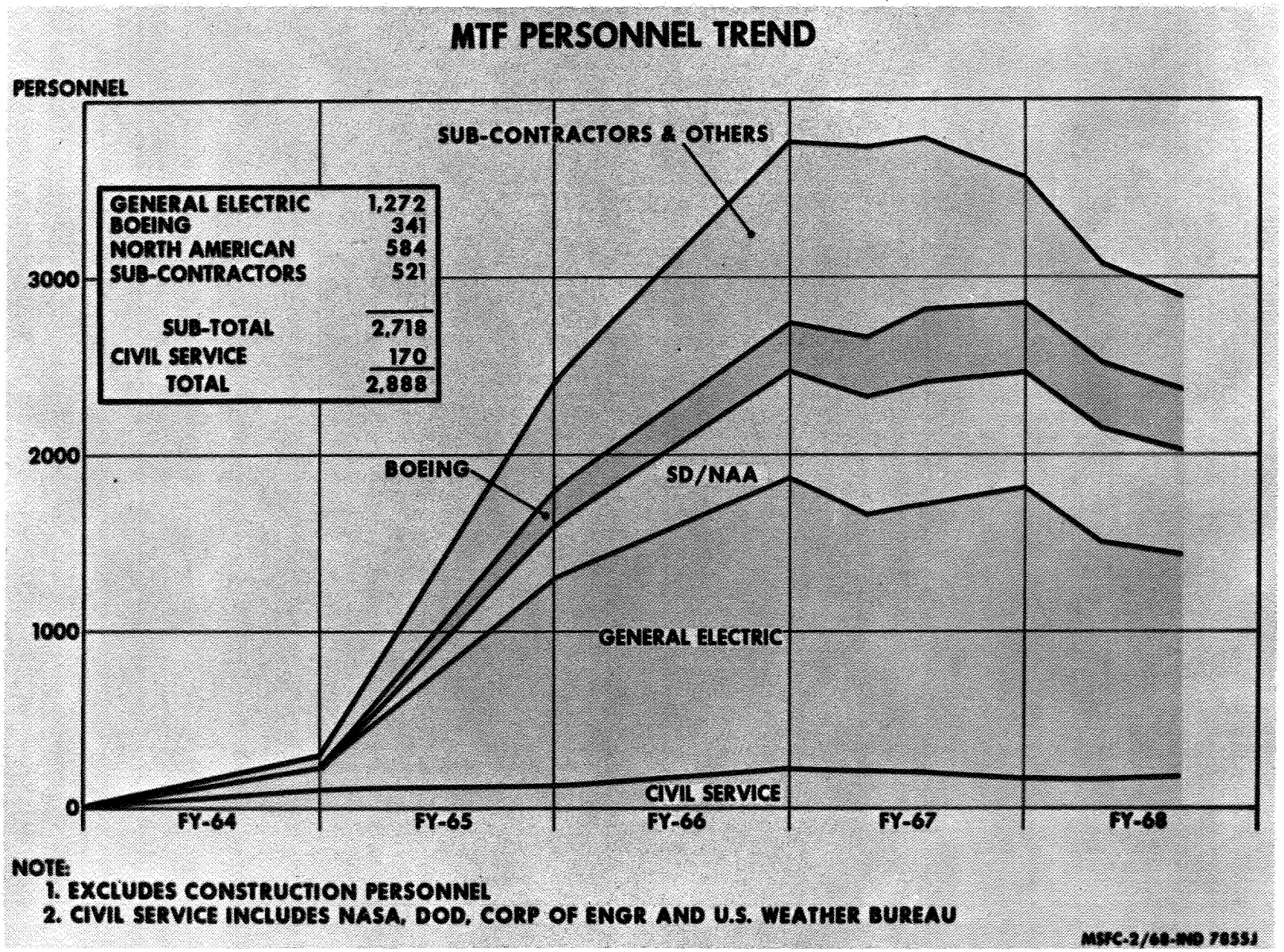
* Holman and Konkel (8) credit Manned Space Flight (MSF) employment between 1960 and 1966 as having contributed to the rate of employment growth in New Orleans as follows: Actual average annual rate of (employment) growth, 3.1; estimated rate of growth without MSF direct, 2.6; estimated rate of growth without MSF direct and induced, 1.9. As indicated in the article, the estimate of induced growth is based on an employment multiplier of 2.27 computed for New Orleans.

† This explanation was revealing because it indicates the subtleties that may exist in attempting to trace impacts of R&D on communities.

FIG. 6



SOURCE: Marshall Space Flight Center, National Aeronautics and Space Administration, Huntsville, Alabama, March 1968

In summary, it appears that the major economic impact on New Orleans of the establishment of Michoud has been the reversal of a rather severe employment situation before 1961, whereas the added noneconomic (or non-quantifiable) impact appears to be confined to a stimulus of the local economy.

By contrast, it appears that the Mississippi experience, at least in one locality, is more similar to that of Huntsville than that of Brevard. The city of Picayune was in an early stage of planned growth at the time of the establishment of MTF, having formed a city planning commission three years earlier. When the decision was made to locate the facility in Hancock County, Picayune responded by absorbing not only many new residents from out of state, but also the majority of families dislocated from the facility's buffer zone as well.*

To accommodate the newcomers, the community floated a bond issue for new schools, built homes, established a cultural center and a $250,000 library, and began a vigorous program to attract new industry. According to a local banker, "a new spirit came to the community--new vigor, less clannish, new outlets for activities." Thus, the pattern again indicates a freshness of approach resulting from the "type of people" who work in a research and development environment.

Again, further indication may be gleaned from upgraded quality of the new educational facilities. In Picayune, 76 new classrooms were constructed. During the summer of 1965, the school district voted to build a new junior high school, floating a bond issue of $875,000 for its construction. In September 1965, the University of Southern Mississippi established an extension center in Picayune, which offers undergraduate courses. Pearl River Junior College located in Poplarville, offers night courses at Picayune. Also Pearl River Junior College recently undertook a $1.5 million expansion and improvement program. Some of the new courses that are offered are specifically designed to equip students with those specialized skills required by NASA. In the fall of 1965, the Jefferson Davis Junior College began operation. The college is located in Harrison County, Mississippi, about midway between Gulfport and Biloxi. The college was designed to accommodate 800 students. Construction was completed, at a cost of about $2 million, in a little over one year.(7)

As another indication, per capita income increased markedly in the area, and was shared by virtually all the inhabitants (Table 5). NASA and its contractors hired about 2,200 local residents--many of whom were unemployed or not part of the labor force--and provided on-the-job training to upgrade their skills.(7)

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* The Mississippi Test Facility consists of "a plantation of some 13,500 acres surrounded by a limited access acoustical buffer zone of 128,000 acres."(16)

Table 5

GROWTH IN PER CAPITA DISPOSABLE PERSONAL INCOME IN HANCOCK, PEARL RIVER, AND HARRISON COUNTIES, MISSISSIPPI 1950-65

Year	Hancock County	Pearl River County	Harrison County
1950	$ 660	$ 695	$ 894
1951	790	833	1,070
1952	834	1,007	1,315
1953	890	870	1,365
1954	861	836	1,325
1955	880	850	1,318
1956	970	936	1,450
1957	932	902	1,393
1958	953	941	1,359
1959	1,062	1,060	1,494
1960	1,138	1,130	1,716
1961	1,160	1,224	1,512
1962	1,237	1,309	1,596
1963	1,291	1,355	1,639
1964	1,408	1,486	1,782
1965	1,486	1,570	1,877
Increase 1962-65	249	261	281
Percentage increase 1962-65	20.1%	19.9%	17.6%

Source: Sales Management, Inc.; Survey of Buying Power, June Issues, as given in Reference 7, p. 104.

Finally, the effort and desire to attract new business to broaden the economic base is being rewarded somewhat, with Standard Container Corporation establishing facilities and "two more to come."

Thus, in southwest Mississippi, NASA's effect has been substantial and positive. Undoubtedly, Picayune stands to lose much if MTF continues to decline, as it has since 1967. Homes and stores are already vacant, bank deposits have decreased by several hundred thousand dollars, and the bond issues must still be paid off. It may be, in fact, that these influences will outweigh the positive ones, as will almost surely be the case if the facility is completely abandoned. On the other hand, much of the "new spirit and vigor" may continue if the door is left open for an alternative use for MTF, if its primary purpose is no longer required.

Impacts on New Orleans and Mississippi are summarized in Table 6.

Table 6

SUMMARY OF IMPACTS ON NEW ORLEANS AND MISSISSIPPI

New Orleans

Reversal of employment slump before 1961
Catalytic effect on stimulating local economy

Mississippi

Improvement in population growth pattern
Increase in per capita income
Virtually elimination of unemployment in the area
Upgrading of skills of local labor force
New spirit and enthusiasm for growth in the community
Much improved public school system
Improved public and cultural facilities
Encouragement and successful attraction of additional industry
Expansion of higher education facilities

Houston, Texas

It is apparent with regard to Houston and the Manned Spacecraft Center, that little can be detected of NASA impact of a strictly economic nature. This is due to the fact, as reported earlier, that Manned Space Flight Employment represents less than 2 percent of total employment in that city.(8)

On the other hand, much change has come to the immediate vicinity of the center, which is located in an area called Clear Lake, between Houston and Galveston. Holman reports (7) that the population of this area increased from 6,520 in 1960 to 32,730 in 1966; that bank deposits increased from $4.8 million to $30.9 million; and that 745 new hotel and motel rooms, 1,313 new apartment units, 1,263 single family dwellings, 925,000 square feet of office space, and 165,000 square feet of shopping center space have been built in the surrounding vicinity (Clear Creek Independent School District and Nassau Bay and Clear Lake City) since 1961.

With regard to the present study, it is again underlying impacts that are sought, thus, indications of changes in per capita income, educational facilities, and so forth are more important than increases in population, housing, and retail sales.

As in the case of New Orleans, it is impossible to detect changes in per capita income in Houston. Invariably they exist, because average salaries of NASA and NASA-contractor employees are considerably higher than the average of other salaries at each location, including Houston. What can be detected, however, are the improved educational facilities that so often follow the establishment of R&D centers.

In Houston's case, the base for this expansion was considerably strong already. In fact, the Houston area, more than any other of the NASA locations in the South had a recognized university environment to build on.

The two universities in the area, Rice and the University of Houston, thus gained, and in turn supplied, much of the impact of the establishment of MSC. For example, NASA Headquarters, through its University Program, established a cross-disciplinary materials sciences laboratory at Rice University, funding it at an average rate of $300,000 per year. This facility has been instrumental in upgrading considerably the materials sciences capabilities at Rice. Furthermore, new and capable men have been attracted to Rice as a result of such a program. In turn, Rice has accepted many graduate students from MSC for full and part-time study--31 in 1964-65 and 25 in 1965-66, for example.(18)

The University of Houston has been even more heavily involved with MSC, as indicated in a report of the center, "Academic Relations at the Manned Spacecraft Center."(18) This report documents many formal courses, university faculty programs, summer programs and resident associateship and fellowship programs instituted at MSC, jointly with the University and MSC sponsorship. This cooperation has resulted in a number of developments, among which was the establishment of a cross-disciplinary engineering course taught by MSC staff members at the University of Houston and the preparation of an outstanding textbook on spacecraft design and fabrication. According to interviews conducted for this study, this textbook has since been used at other universities, including Texas State and Louisiana State University.

Because of the demand for additional courses of instruction, the University of Houston now teaches 15 graduate courses at MSC, including management and political science, as well as engineering, mathematics, and physics. The University is now establishing a new graduate school on a site adjacent to MSC on land donated by the Humble Oil Company. According to representatives of the center, this new facility represents an investment of more than $3 million at the outset, and is expected to serve a community of 80,000 people eventually in the Nassau-Clear Lake area.

Other examples exist such as the establishment of the Lunar Science Institute under joint sponsorship of Rice, NASA, and the National Science Foundation. All of these elements are representative of the pattern found in Huntsville. Although it may not be possible to credit NASA with the entire series of developments (in fact, it would be incorrect to do so), the influence of the establishment of the center at Houston goes much beyond mere numbers of people and a government payroll, just as it does elsewhere.

Finally, impacts on Houston and the Clear Lake Area are summarized in Table 7.

Table 7

SUMMARY OF IMPACTS ON HOUSTON-CLEAR LAKE AREA

Direct Economic Impacts*

	1960	1966
Population	6,500	33,000
School enrollment	1,900	6,700
School bonds (in millions)	$2.4	$ 7.4
Bank deposits (in millions)	$4.8	$30.9
Residential construction†	--	1,260

Other Impacts

Expansion of higher education facilities in general
Establishment of cross-disciplinary materials science laboratory at Rice University
Establishment of University of Houston Graduate School
Establishment of Lunar Science Institute
Dramatic change in character of Houston, expressed in pride in being a Space Center
Great expansion in number of firms locating in area, primarily to serve NASA, but expanding to other markets as well

* As given in Reference 7.
† New since 1961.

RECOMMENDATIONS FOR FUTURE STUDY

The previous chapters have indicated briefly a number of impacts of NASA on local communities, which may, with further study, be more fully explained. For example, quantitative analysis may be made of the changes in education that have taken place by using average grades on test scores, number of students now entering college, student-teacher ratios, and other indicators. Furthermore, additional productive study could be undertaken with regard to industrial development in the vicinity of the southern NASA centers. Much of this development has taken place as a direct result of NASA requirements, with the industrial concerns selling primarily to NASA. Some companies have developed external markets as well, however, and it would be useful to categorize these developments.

Further documentation is needed of the means whereby graduate and undergraduate curricula are revised, updated, and extended. Methods used to encourage the establishment of the Research Institute in Huntsville should be ascertained, with the thought that similar developments might be encouraged in other areas. As indicated in the text, relationships between R&D installations and academic communities are very close as a general rule. While it is sometimes difficult to establish which follows which, it is nevertheless true that advantages flow from better educational as well as R&D facilities. Since the South particularly needs such improvements, means for their encouragement should be identified and implemented wherever they may be warranted. For this reason, SRI strongly recommends further study of these and other means for economic growth that have been and can be further affected by NASA.

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