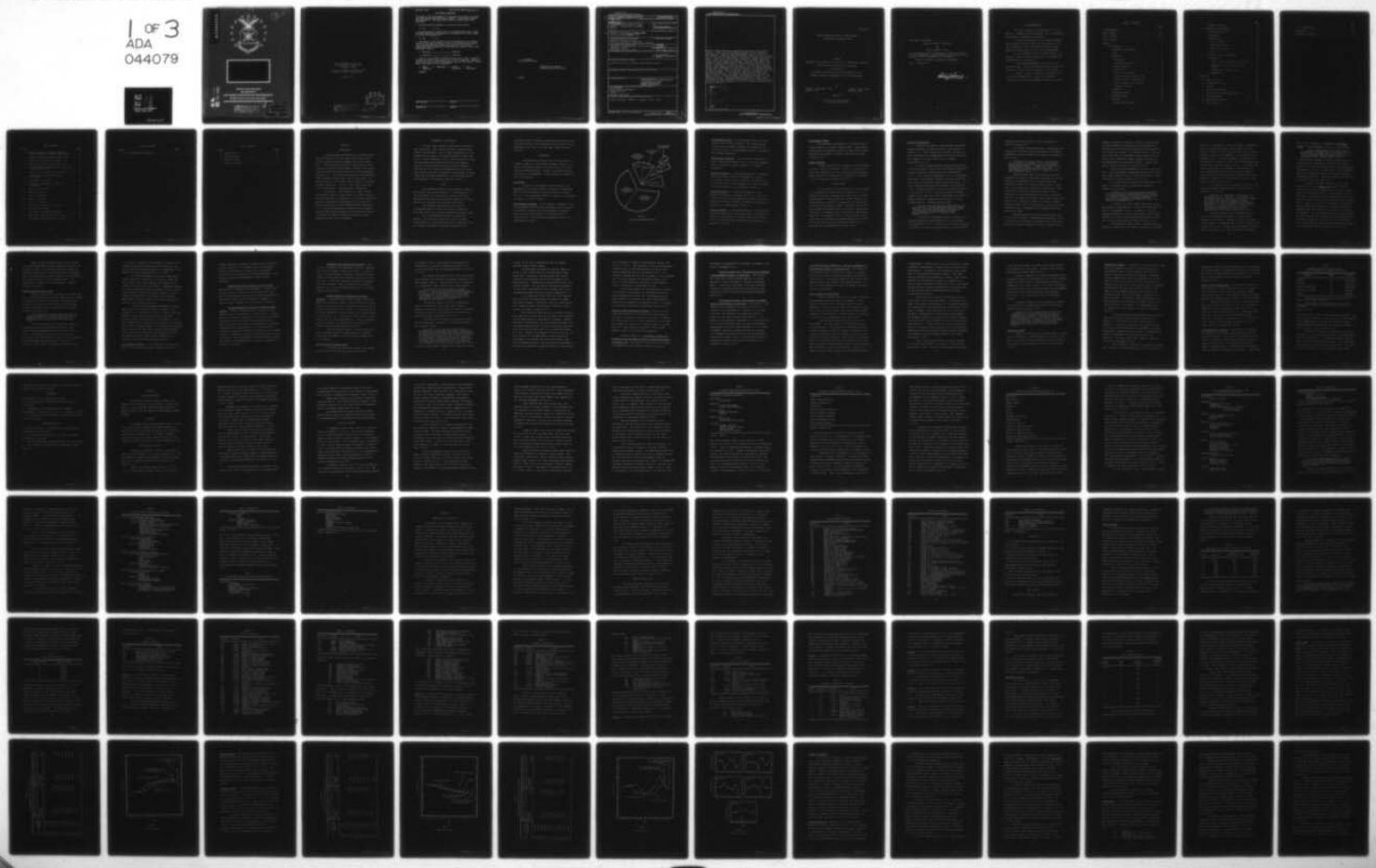
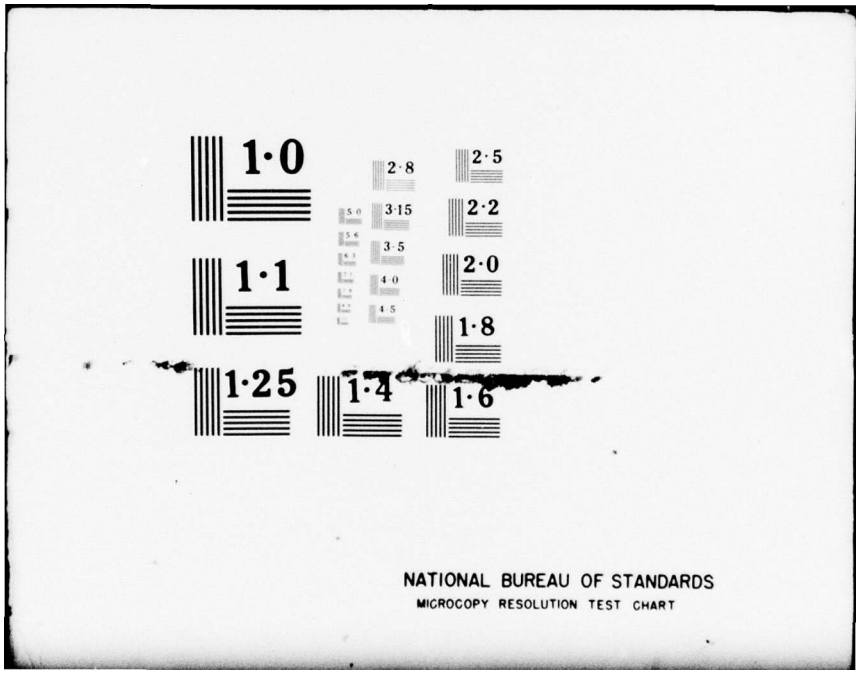
AD-A044 079 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCHO--ETC F/G 1/5
THE ENVIRONMENTAL IMPACT OF BASE CLOSURE: A CASE STUDY OF LARED--ETC(U)
JUN 77 R O CARDINALE, R E KOHN

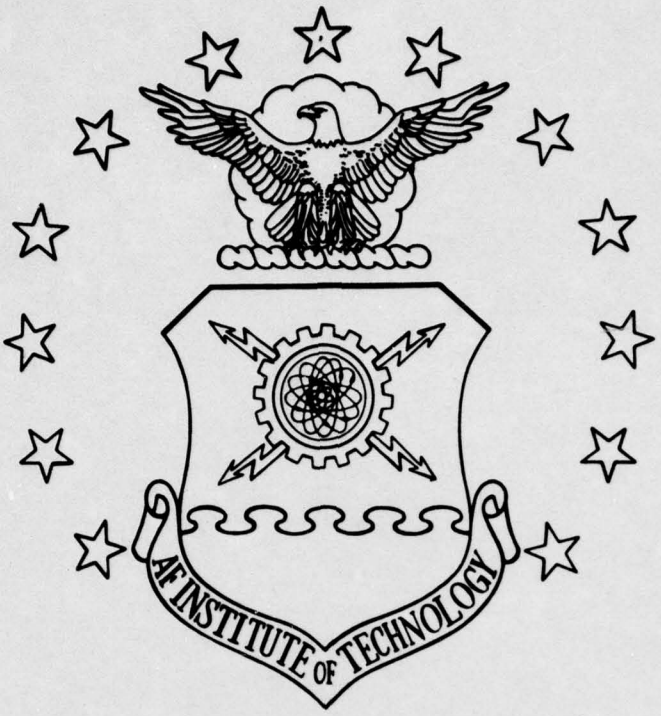
UNCLASSIFIED AFIT-LSSR-8-77A NL

1 OF 3
ADA
044079




1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5
2·8
3·15
3·5
4·0
4·5
5·0
5·6
6·3
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

(3)



UNITED STATES AIR FORCE

AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

THE ENVIRONMENTAL IMPACT OF BASE CLOSURE: A CASE STUDY OF LAREDO, TEXAS

Richard O. Cardinale, Captain, USAF
Ronald E. Kohn, Captain, USAF

LSSR 8-77A

USAF SCN 75-20B AFIT Control Number LSSR 8-77A

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: AFIT/SLGR (Thesis Feedback), Wright-Patterson AFB, Ohio 45433.

1. Did this research contribute to a current Air Force project?

   a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

   a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Can you estimate what this research would have cost if it had been accomplished under contract or if it had been done in-house in terms of manpower and/or dollars?

   a. Man-years _____ $ _____ (Contract).

   b. Man-years _____ $ _____ (In-house).

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3 above), what is your estimate of its significance?

   a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments:

Name and Grade _____ Position _____

Organization _____ Location _____

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

AFIT/LSGR (Lt Col Barndt)
Wright-Patterson AFB, OH 45433

AU FORM JUL 74 6

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AFIT- REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: LSSR-8-77A	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): THE ENVIRONMENTAL IMPACT OF BASE CLOSURE: A CASE STUDY OF LAREDO, TEXAS.	5. TYPE OF REPORT & PERIOD COVERED: Master's Thesis, / 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Richard O. Cardinale, ~~Captain, USAF~~ / Ronald E. Kohn, ~~Captain,~~ USAF	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Graduate Education Division, School of Systems and Logistics, Air Force Institute of Technology, WPAFB OH	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: Department of Research and Administrative Management (LSGR), AFIT/LSGR, WPAFB OH 45433	12. REPORT DATE: June 1977 / 13. NUMBER OF PAGES: 189 (12 202 p.)
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED / 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

APPROVED FOR PUBLIC RELEASE AFR 190-17.

JERRAL F. GUESS, CAPT, USAF
Director of Information

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

ENVIRONMENTS
ENVIRONMENTAL ASSESSMENT
FACTOR ANALYSIS
IMPACT
MILITARY FACILITIES

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Thesis Chairman: Patrick J. Sweeney, Lt Col, USAF

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

012 250

Military bases exercise a significant influence on many communities. A base closure inevitably creates strong community apprehension. Many of these apprehensions can be allayed once the impact of a military base on a nearby community is fully understood. The DOD has been unable to accurately assess the environmental impact of a military base closure on a nearby community; hence, they have begun to establish a data base from which environmental impact assessments of base closures can be made. This research examined the closure of Laredo Air Force Base, Laredo, Texas. The research objectives were to identify factors changed significantly subsequent to base closure, and to determine if that change was attributable to the base closure. The methods employed in analysis were: factor analysis, time-series analysis, and subjective analysis. The research revealed that three major factors existed which explained the environmental impact of the base closure: the Growth Factor, the Extrinsic Factor, and the Intrinsic Factor. The researchers concluded that there was no significant impact apparent in the Growth Factor, while there was a significant impact apparent in both the extrinsic Factor and the Intrinsic Factor.

LSSR 8-77A

THE ENVIRONMENTAL IMPACT OF BASE CLOSURE: A CASE STUDY OF LAREDO, TEXAS

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Facilities Management

By

Richard O. Cardinale, BSME
Captain, USAF

Ronald E. Kohn, BSCE
Captain, USAF

June 1977

This thesis, written by

Captain Richard O. Cardinale

and

Captain Ronald E. Kohn

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN FACILITIES MANAGEMENT

DATE: 15 June 1977

Patrick J. Sweeney
COMMITTEE CHAIRMAN

ACKNOWLEDGEMENTS

We wish to express our appreciation to Lt Col Patrick J. Sweeney, our thesis advisor, for his assistance and guidance in completing this thesis.

Our gratitude goes also to the public employees and officials of Laredo, Texas, and particularly to Col (Ret.) Gaillard R. Peck, the Laredo Municipal Airport Manager and past Laredo Air Force Base Wing Commander.

We owe particular thanks to Sandy Anderson, our faithful typist, for true craftsmanship in preparing the proposals and the final thesis.

A special acknowledgement is due our wives, Sandi and Jean. Their understanding and moral support led directly to the successful completion of this thesis.

Finally, we wish to express our appreciation to our fellow researchers for ideas, source material, critiques, and honest encouragement throughout the year.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF CHARTS

Chapter 1

INTRODUCTION

A period marked with reduction of military forces and inactivation of military bases followed each war in which the United States had engaged during this century (2:1). Those actions were a part of the process of readjusting to a peacetime environment; likewise, those actions were consistant with the philosophy of a small peacetime military (2:1). The reductions associated with achieving a small peacetime military were "felt in three areas: the national economy, the defense industry sector, and defense-oriented communities... [2:2]." This research will deal with the third area: defense-oriented communities.

Specifically, this research will deal with the environmental impact of base closure on a nearby community. From the experience of communities in which base closure had occurred, assumptions and predictions can be made which might be applicable to other defense-oriented communities (2:3). When the Department of Defense (DOD) can predict potential environmental impacts of base closures on nearby communities the negative effects of attaining a small peacetime military may be mitigated.

STATEMENT OF THE PROBLEM

Military bases exercise a significant influence on many communities. Base closure inevitably creates strong community apprehension. Many of these apprehensions can be allayed once the impact of a military base on a nearby community is fully understood (41:37). The problem is--the DOD has been unable to accurately assess the environmental impact of a military base closure on a nearby community. Both desirable and undesirable changes result from a given base closure; the lack of systematic identification of these changes has prevented enhancement of the beneficial impacts and mitigation of the negative impacts (54:Part I).

SCOPE

This research assesses the environmental impact of base closure upon a nearby community. Placing emphasis on the full analysis of the economic, physical, and social indicators which comprise environmental impact, the topical scope of this research is a case study (13:79-80).

The case study specifically deals with the environmental impact of the 1973 closure of Laredo Air Force Base (AFB) upon the nearby community of Laredo, Texas.

The Civil Engineering Center at Tyndall AFB, Florida, is constructing a model with which to predict future impacts of base closure upon nearby communities (44). This research complements the model building effort by

providing a base of knowledge concerning the processes that took place and the inter relationships that occurred when a moderately sized base (44) closed near a small community (27:216).

TERMINOLOGY

The terminology normally used in discussing environmental impact is in some respects highly technical. To insure understanding, some of the terms used in the introduction are defined herein. Whereas, those more technical terms used in the remainder of this research are defined as they are introduced.

Environment

As used in this research the environment is the aggregate of surrounding things, conditions, or influences which affect the existence or general welfare of mankind (43:477). The environment consists of factors as illustrated in Figure 1 (14:78-80; 26:85).

Environmental component. An environmental component is one of the elements into which the environment can be resolved. The economic, physical, and social components represent areas into which the concerns of individuals and the community fall. An environmental component is made up of environmental factors.

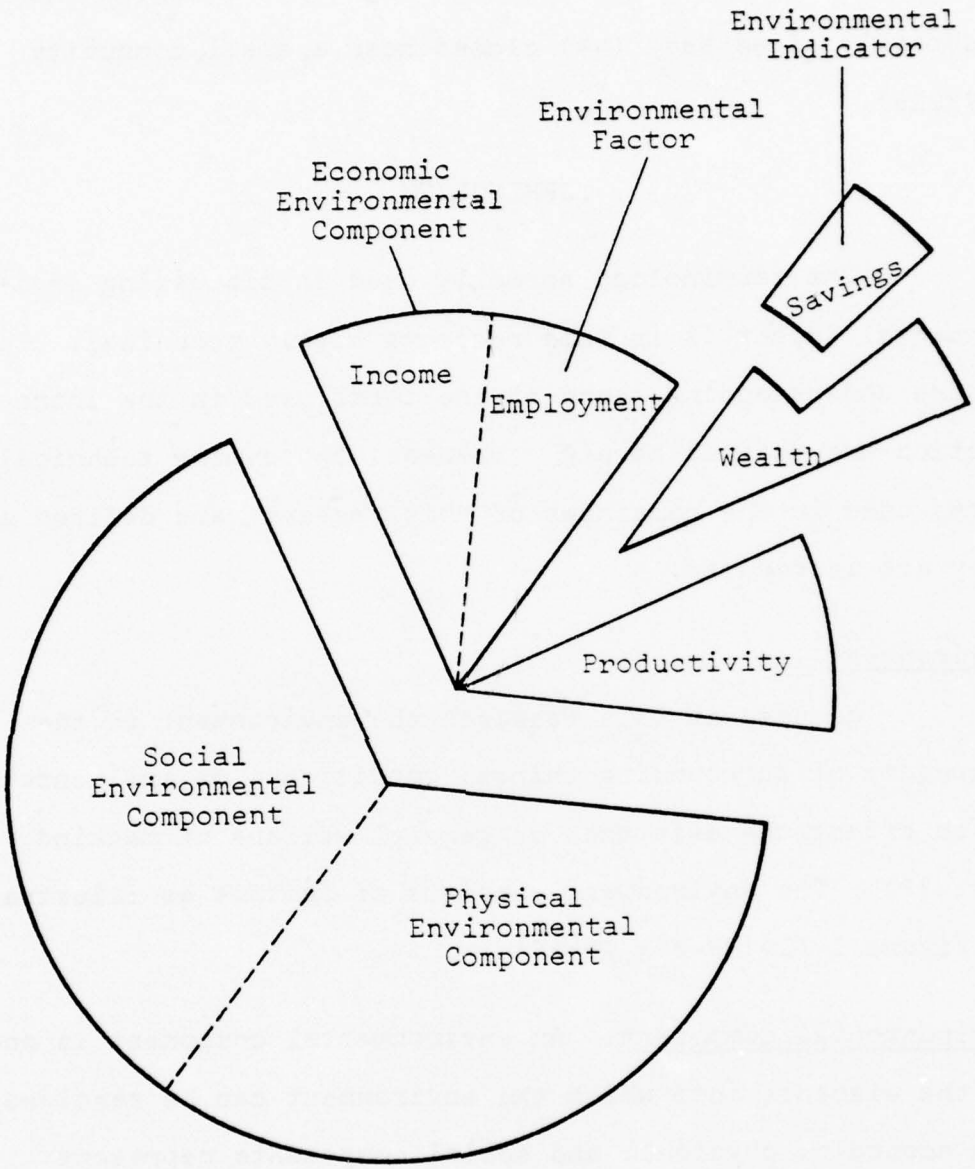


Figure 1

The Environmental Hierarchy

Environmental factor. An environmental factor is a constituent part of the environment. The factors are portions of the environment concerned with aspects of the activities of man. An environmental factor is composed of environmental indicators.

Environmental indicator. An environmental indicator is a direct quantitative measure used to facilitate judgements about the condition of major aspects of a society's environment.

Economic indicator. A quantitative measure of financial moods or movements which affect production, layoffs, performance, assets, prices, contracts, business formations, stock prices, money balances, new orders for goods, construction permits, and inventories (38:66-67).

Physical indicator. A quantitative measure of the presence or absence of chemical, natural, or biological forces which alter the environment and affect health, biosystems, structures, equipment, recreational opportunity, aesthetics, or natural beauty (52:1-1).

Social indicator. A quantitative measure of objective and subjective perceptions of life experience. The former, for example, includes health, education, crime, and mobility, while the latter includes satisfactions, aspirations, and alienations (19:3).

Environmental Impact

The desirable, undesirable, or indifferent consequence evinced by a change of baseline data. Additionally, as used here, environmental impact is a quantifiable effect resulting from changes in economic, physical, and social indicators (44).

Nearby Community

A nearby community could certainly include hundreds of cities, towns, and villages. However, as used here it means that community which could suffer significant environmental impacts as a consequence of a specific DOD decision to close a contiguous military base (41:2).

JUSTIFICATION

It is unlikely that a problem will be solved unless it is recognized and identified as a problem (27:3). The problem of accurately assessing and predicting the environmental impact of a base closure on a nearby community was recognized with a plethora of legislation, DOD directives, and Presidential Executive Orders. The Army, Navy and Air Force became increasingly aware of the need to develop new techniques to accurately predict the effect a base closure would have on a community (42:5). The responsibility for constructively attacking the problem rested within the DOD, and in the case of Air Force bases the responsibility devolved upon the Department of the Air Force.

Historical Perspective

Assessing the impact of base closures upon nearby communities became an important topic in the economics of defense (7:1). Base closures were primarily the result of the consolidation and reorganization of military facilities which began in the early 1960's with the Kennedy administration (7:1).

In 1961, President Kennedy indicated in his State of the Union Messag[illegible] that he had instructed the Secretary of Defense to eliminate obsolete bases and installations (28:6). A task force was immediately set up to investigate, among other crucial areas of defense, military facilities with special consideration toward possible reduction. As a result, seventy-three bases were proposed for elimination (28:6). The announcements of those base closures were made on March 28 and 29, 1961. Those announcements differed, however, from former base closure announcements in that the Federal Government recognized the possibility of environmental impact. President Kennedy stated:

> I am well aware in many cases these actions will cause hardships to these communities and individuals involved. We cannot permit these (closure) actions to be deferred; but the Government will make every practicable effort to alleviate these hardships [28:7].

In response to President Kennedy's statement, the Pentagon immediately established the Office of Economic Adjustment (OEA) (28:7). In addition, an advisory committee was formed by the White House consisting of various cabinet

members and economic advisors to assist primarily on economic problems (28:7).

In a letter dated November 1964, introducing a DOD publication, President Johnson re-emphasized the Federal Government's position toward those communities affected by base closure.

> We expect to receive a dollar value for every dollar we spend on defense. To do so has meant we must eliminate surplus, obsolete, and unnecessary Defense installations... (W)hen it is done, we have an obligation to assist the individuals and communities affected to adjust to changes in their local economics [28:8].

Between January 1961 and December 1968, the DOD designated 918 bases and industrial facilities for closure, cutback, or inactivation; the resultant savings were projected at nearly $1.5 billion annually (28:8). Though many of the 918 actions involved small facilities or unit relocations, there were a surprising number of major facilities such as the Portsmouth Navy Yard, the Brooklyn Navy Yard, four large air material areas, many Strategic Air Command bases, several Army camps, and numerous ordnance plants and depots (28:9). The big year in that era for base closures was 1964; subsequently, an interesting constitutional issue arose.

Congress resisted the numerous base closures and, in June 1965, the House of Representatives attached a rider to the Military Construction Authorization Act. The rider included provisions to permit a majority of either House of

Congress to prevent a closing of a specific military base. The Senate rejected the provision, but stipulated that advance notice to the House and Senate would be required on any future base closures. The Senate version was included in the final bill, but President Johnson vetoed even this version with a warning to Congress against meddling with the prerogatives of the Executive Branch. Congress then passed a revised version of the bill (28:8-9).

Base closure announcements of January 19, 1967 and May 13, 1968 were largely reorganizational in nature, however, later actions of April 24, 1969 and October 29, 1969 accounted for 320 base closures (28:9; 41:14).

In an excerpt from a White House Memorandum to the heads of seventeen Federal departments and agencies President Nixon stated:

> On March 4, 1970, I established the Interagency Economic Adjustment Committee to assist individuals and communities that suffer adverse economic impacts as a result of necessary Defense realignments. I now intend to strengthen the Committee's efforts and expand its membership [41].

On March 6, 1970, the largest single base closure announcement to date was made: 341 actions involving 69,614 jobs to be eliminated (41:14). On April 17, 1973, the Pentagon announced 274 actions, among them 40 major installations to be closed; these actions were expected to save $3.5 billion over the next ten years (41:13-14; 55:68).

"The Pentagon's latest cutback of defense jobs and shutting of bases across the nation is a taste of more ahead

[32:40]." On November 22, 1974, DOD ordered a realignment which would save $300 million over the next ten years (32:40). "Scores of cities and towns near the 111 installations involved will be affected by the closings and other changes [32:40]." The key installations involved in the announcement of November 22, 1974, were Richards-Gebaur AFB, Missouri and Scott AFB, Illinois (32:40). It was the court action filed against the movement of Headquarters, Air Force Communications Service (Hq, AFCS) from Richards-Gebaur AFB to Scott AFB in June 1975 that provided initial impetus to research into the environmental impact of base closure questions (26; 45; 48).

As an introduction to a pamphlet published by the Economic Adjustment Committee (EAC), President Ford, on January 15, 1976, wrote:

> Decisions to close military installations are never made lightly. Each case is considered individually and no decision is made without weighing its consequences for the community affected... In most cases, the setbacks triggered by Defense realignment decisions can be substantially offset, eliminated or, in many instances, turned to economic gain for the communities...the key to these successful recoveries is the dedication and determination at the 'grass roots' level [42:1].

Providing evidence of the implementation of the intent of President Ford's comments, subsequent news releases by the Office of Assistant Secretary of Defense (Public Affairs) no longer carried the blunt message of base closure (35; 36; 37). Instead the announcements of March 11, March 17, and April 1, 1976 all carried the key message

that closure, reduction, or realignments were being studied. The announcement of March 11, 1976 included:

> ...today's announcement is the first step in the process of compliance with the National Environmental Policy Act (NEPA) that will result in a full Environmental Impact Statement (EIS) prior to a decision on each candidate action [35:1].

In these separate releases, the Navy announced plans for seventy-four base realignment, reduction, and closure actions (36:1), the Army announced plans for eighteen base realignment actions (37:1), while the Air Force announced plans for an unspecified number of base reductions and realignments including: Craig AFB, Alabama; Kincheloe AFB, Michigan; and Webb AFB, Texas (35:1).

Similar to Congress' attempt to control base closures in 1965, the Federal Times reported that the Military Construction Authorization Bill for 1976 carried another base closure provision. The delimiters of the bill were based on the number of civilian employees that would lose jobs. The provision called for any decision to close a base to undergo nine months of environmental and economic analysis along with three months of congressional review. President Ford vetoed the bill as written at the urging of the Pentagon. For the future this bill would have required at least a one year delay between the announcement of, and the effective date of, a base closure or major reduction. For 1976 it would have also meant delaying sixteen proposed base closures and cutbacks for twelve months (20:1).

Hence, the environmental impact of base closures upon nearby communities had been recognized in the past as a serious problem. The foregoing historical perspective provided a recognition of the problem from a Governmental point of view and the next section explains the importance of the problem in light of the environment itself. The environment is composed of three components: economic, physical, and social.

Economic Impact of Base Closure

Anderson noted that the location of a base and the kind of activity performed there were dependent upon a number of geographic and economic indicators. Between the two, geography was the prime consideration but among several geographic alternatives the economics of the situation dictated the choice (2:12).

> For these reasons military bases are often in relatively isolated locations, and they provide the greatest portion of the economic base for the communities that develop around their perimeters [2:12].

The DOD displayed direct and sincere concern for assisting and advising communities impacted by base closure when the Pentagon established the OEA in 1961 (28:ix). The objective of OEA was to assist those communities which were impacted by base closure in meeting their unemployment and other economic problems (7:4). Further, in 1970, the EAC was created by President Nixon

(7:4; 12:155). Chaired by the Secretary of Defense, this committee was tasked with assisting individuals and communities adversely impacted because of a realignment of the Nation's military base structure (7:4; 12:155).

In a report prepared by the OEA, a three phase economic impact on communities was noted as a result of base closure. The initial reaction was normally one of dismay at the loss of jobs and income. A secondary reaction was one of apprehension that the community could not react quickly enough to offset the economic impact. A third reaction concerned what the community could physically derive from the base, in the way of military property, to improve its own economic status (41).

A base closure announcement represented a recognizable crisis which permitted community leaders to work together (28:x). The efforts of the DOD, through OEA, were directed toward long term solutions to a community's economic problems resulting from a base closure. As such, Lynch summarized the principles of the strategy evolved from the Economic Adjustment Program. The strategy was developed based on twelve individual case studies of base closures. Lynch noted that the principles were applicable to other communities affected by base closure irrespective of geographic and political considerations (28:xi).

OEA strategy principles. As a perspective on the economic impact of base closure on a nearby community, the OEA

strategy principles offered an excellent basis of subjective economic indicators. At the same time the OEA strategy provided justification for research into the economic indicators to be discussed in the succeeding chapters. The strategy principles are summarized in the following paragraphs:

Recognize the economic impact of base closure. A community had to recognize its dependency on a nearby base and had to adjust to the fact that the base would close. Delay in accepting an impending base closure eliminated any possibility of early recovery planning. Similarly, community power struggles had to be avoided (28:xi-xiii).

Evaluate community potential for economic impact recovery. Community leadership had to evaluate the base assets and had to determine how to exploit them. A pointed economic development strategy had to be defined and directed toward those uses which offered the greatest promise of adapting the base facilities to the locational and personal characteristics of the community. The community had to establish a data base of economic information. The financial ability of a community to acquire the base facilities had to be assessed. Once the potential for economic impact recovery was evaluated the community had to develop a commitment to recovery (28:xi-xiii).

Commitment to economic impact recovery. Hard work by the community was necessary to recover, therefore, they could not assume a defeatist attitude. In order to induce a future industrial attraction, communities had to improve the skill levels and technical abilities of their work force. A definite commitment to specific industries had to be developed. When the commitment was made the community had to achieve maximum utilization of its total resources (28:xi-xiii).

Maximum effective utilization of economic resources. Successful recovery had to exploit previously overlooked resources to adapt to new processes and products. Special care had to be taken to preserve the facilities the community had acquired from the base. The community had to be sure to examine all economic opportunities before making final decisions. And, the community had to maintain close contact with its state administration. Finally, throughout the entire process, the community had to maintain its momentum toward economic growth (28:xi-xiii).

While the economic impact of a base closure on a nearby community became a mounting concern to affected communities, the effect on the physical environment could not be ignored.

Physical Impact of Base Closure

In the last few generations, mankind has accelerated the drive to protect and enhance the physical

environment (27:17). Each generation has accepted the responsibility of being the recognized trustee of the physical environment for succeeding generations (33:4200-2 (1 of 3)).

The Federal Government, the DOD, and the Air Force placed emphasis upon physical environmental planning (23:1). Major General McGarvey, a past Director of Civil Engineering, Headquarters, USAF, stated the Air Force position:

> The purpose of the environmental planning process is to avoid or minimize adverse impact--not justify it. The determination of the best alternative in consideration of all the facts and their inter relationships is the methodology which will insure that the Air Force mission is sustained and accommodated--on time [3:6; 31:33].

The present Director of Civil Engineering and Services, Headquarters USAF, Major General Robert C. Thompson, established a requirement to identify and develop methods to insure that all environmental amenities were given appropriate consideration (3:6; 49).

Realizing that all physical environmental impact was not immediately discernable, Liu summarized another very important caveat.

> All types of pollution are grouped under the individual and institutional environment because they are different by-products of various human activities. Evidence suggests that the direct effects of pollution on property, on human health, and on the quality of life are varied. Their direct damages, however, may ultimately prove to be even less critical for society as a whole than the latent effects of pollution on the ecological systems that sustain human life [27:63].

In effect, the secondary physical impact deserved at least

as much, if not more, consideration than the primary physical impact of base closure.

In addressing the problem of physical impact as a result of base closure, the Air Force expanded its Base Master Plan. Previously, the Base Master Plan focused primarily on the physical layout and development of the base facilities. Redefined as the Comprehensive Plan, the concept included: (1) physical and man-made environments, (2) the social characteristics of the people, and (3) the dependencies between the base and nearby communities (50).

It is important to note that since 1969, approximately 200 court actions resulted in delays to intended base mission changes. These delays might have been avoided with a predictive model of the physical impact of a base closure on a nearby community (3:6).

The literature concerning the environment indicated that legislative actions provided the impetus and foundation for the establishment of environmental programs. Congress established, through NEPA, that the Federal Government had a continuing responsibility "to create and maintain conditions under which man and nature can exist in productive harmony [10:2712]." Briefly, the purpose of NEPA was four fold: to state a policy to encourage harmony between man and his environment, to stiumulate the health and welfare of man while eliminating damage to the environment and biosphere, to emphasize the importance of natural resources to the Nation,

and to establish a Council on Environmental Quality (CEQ) (10:2712; 51:1-2). "The enactment of this law established a national policy of encouraging productive and enjoyable harmony between man and his environment [23:1]." The President, signing NEPA into law on January 1, 1970, heralded the 1970's as a decade of environmental concern (23:1). Title I of NEPA established the policy on environmental quality, while Title II established the CEQ.

The CEQ was responsible for studying the condition of the Nation's environment, for developing new environmental programs and policies, for coordinating environmental matters, for insuring that other Federal agencies comply with environmental considerations, and for assisting the President in assessing environmental problems (23:1).

Executive orders and agency responses. Several Executive Orders were issued by the President and Federal agencies responded with internal guidance and directives to enhance and explain NEPA (23:3). A brief examination of the important elements of the Executive Orders and agency responses along with other directives pertinent to the proposed research follows in the succeeding paragraphs.

Executive Order 11752, "Prevention Control, and Abatement of Air and Water Pollution at Federal Facilities," 17 December 1973. The purpose of this order was to insure that leadership in the effort to protect the physical

environment was undertaken by the Federal Government in its facility management (23:4).

Executive Order 11514, "Protection and Enhancement of Environmental Quality," 5 March 1970. The purpose of this order was to direct Federal agencies to initiate measures to direct attainment of national environmental goals. In addition, it assigned to the CEQ the responsibility of advising and assisting the President while leading the effort to attain the national environmental goals (23:4).

DOD Directive 6050.1, "Environmental Considerations in DOD Actions," 19 March 1974. The purpose of this directive was to establish the policy of the DOD as a trustee of the environment and to carry out its mission consistent with established environmental standards. Toward this end, DOD components were directed: (1) to assess all environmental consequences of a proposed action, (2) to review all prior actions for which environmental consequences may not have been considered, (3) to utilize a systematic approach to decision making and planning, (4) to prepare and process an EIS on any environmentally controversial issues, and (5) to develop alternatives to recommended courses of action for those actions with unresolved conflicts (23:4).

Air Force Regulation (AFR) 19-1, "Pollution Abatement and Environmental Quality," 20 February 1974. The purpose of this regulation was to establish the basis for a program within the Air Force to protect and enhance environmental quality (23:4). The physical impact of base closure upon a nearby community has received considerable emphasis; however, the social impact is of equal or greater importance in the total environment.

Social Impact of Base Closure

There is a great need for social impact thinking by environmental-conscious planners and managers. Society reacts to situations as it perceives them; if society perceives a situation as real, then that situation is real. If an action provokes a public controversy because society perceives it as a threat to a certain quality of life which it values, then the consequences are real (22:104).

Jain associated three dimensions with a social environment: (1) human ecology, (2) collectivities, and (3) psychological. The human ecology dimension concerned society's interaction with its physical surroundings, for instance, interaction with the community as well as interaction with the military base. Human ecology also included society's interaction with physical resources; this interaction commanded attention because society's social environment was dependent upon its surroundings. Land use, in a human ecological sense, controlled the predominent makeup of

a neighborhood. A major action such as a base closure caused penetration, displacement, or modification of entire social neighborhoods. For example, white residential zones became black or fields became industrial sectors. Also, human ecology concerned the distribution of people. Base closure affected the distribution of people in a community, by changing where they worked or where they lived. While human ecology involved societal interactions on a personal basis, collectivities involved group interactions with their surroundings (22:105-107).

Jain viewed the collectivities dimension as the second part of the social environment. Collectivities were larger, more complex organizations with designated objectives. The collectivities dimension concerned the community's type, number of people, social and political history, and class structure. Consideration of the collectivities dimension was extremely important in a base closure situation because it was the level at which most actions and policy decisions were carried out. Collectivities also included the interaction of influential decision makers upon the entire group. Communities hold more power and influence than an individual and, therefore, can have a greater impact on the social environment (22:107).

Last, Jain considered the psychological dimension of the social environment as the quality of life and the group point of view. Quality of life concerned the choices

of life styles available to society; base closure affected the alternatives of life styles. Similarly, base closure affected basic societal needs (22:107).

Viewing a community as a complex organization with a designated mission and objective (22:107), the relationship between a military base and its neighboring community was characterized as a social contract. The social contract was broken when a base closure action occurred and the dimensions associated with the social environment were impacted (22:110-111). This social impact caused severe social problems.

A growing interest in social problems was derived from reactions to the materialism that had traditionally pervaded the United States (27:24).

> Marginal utility or satisfaction derived from a higher level of consumption produced by great technological improvement in the past decades has diminished substantially. Social issues such as housing segregation, income distribution, discrimination and equal rights, education, health and social justice and fairness, and welfare are mounting concerns among the majority of Americans today [27:24].

Community Overview

Laredo is located on the Rio Grande River, 145 miles south of San Antonio. Laredo's population is about 76,000 while its companion city on the Mexican side of the river, Nuevo Laredo, has a population of 152,000 and is growing (41:116).

Evaluation of impact. As concluded by the EAC in a July 1973 report to Congress (41:116-118), Laredo would feel the environmental impact of base closure in the short run; however, the long run picture was brighter. Continuing, the EAC commented that unless new employment was quickly found, the loss of 523 DOD civilian jobs and about 1,400 military jobs could have a serious effect upon the community. Estimates were that the total civilian jobs lost could reach 2,300 as community businesses felt the loss of a combined military and civilian payroll, totalling $27.8 million annually. In addition, normal operations at the base paid local firms more than $1.7 million annually for various services. The January 1973 unemployment rate of 12.9 percent could have reached 20 percent by September (41:116).

Further complicating the impending impact were the base housing assets and the military residing in the community. The base had 476 family housing units in addition to 1,000 other living units for single military. The value of local housing could be depressed if the base housing were introduced into the market. To compound the matter, an estimated 1,200 military resided in the community. Upon base closure their demand for community housing would disappear (41:116).

EAC additionally noted that the closure would weaken the city's tax base and simultaneously limit its ability to

finance much needed physical improvements such as new storm and sanitary sewers, road paving and recreational facilities. Also, the city's teaching staff was expected to be cut back when 550 school aged children who lived on the base departed (41:117).

Quality of life findings-1970. The primary objective of a study conducted in 1970 by Ben-Chieh Liu was to quantitatively assess the urban quality of life and to analyze variations in quality of life components among 243 Standard Metropolitan Statistical Areas (SMSA's) in the United States (27:v). There were 95 SMSA's in the U.S. with populations less than 200,000; by definition of the U.S. Department of Commerce these were classified as small SMSA's (27:172). Laredo was in the small SMSA group. Liu indexed and rated each SMSA. Table 1 indicates the standing of Laredo relative to the other 94 small SMSA's (27:173,179,186,193, 199). Based on Liu's findings, the quality of life in Laredo, Texas, was substandard (27:205).

EAC assessment of prospects. Based on the environment as it existed in 1973, the EAC assessed Laredo in both the short and long run. In the short run the prospect of the community's ability to provide jobs for those released by the base was very poor. The community's low level of skills, isolated location, and needed public improvements were not amenable to attracting new industry. Unemployment

Table 1

Index and Rating of Various Quality of Life Components for Laredo, Texas (1970)

Component	Rank*	Rating**
Economic	95	Substandard
Political	91	Substandard
Physical Environment	88	Substandard
Health and Education	71	Adequate
Social	69	Adequate

*The rank was on an ordinal scale from 1 to 95 where 95 is the least desirable.

**The rating was on an ordinal scale in five increments: outstanding, excellent, good, adequate, and substandard.

Source: Liu (27).

in the early 1970's ranged from nine to twelve percent. The local officials predicted a rise of as much as eleven percent in the unemployment rate because the local work force, eighty percent Mexican-American, were usually reluctant to accept new jobs in other cities (41:118).

However, the long run picture according to the EAC was better. Tourism was a major industry; accommodations for tourists were enlarged. The community planned to upgrade skill levels through vocational training. Additional roads were identified to provide access to new areas. And, some of the more necessary public improvements were planned.

Therefore, as the EAC saw it, Laredo would recover from the impact of base closure (41:118).

OBJECTIVES

The objectives of the proposed research are:

1. To identify factors which represent the community environment.
2. To ascertain if the identified factors changed significantly subsequent to the closure of Laredo AFB, Texas.
3. To determine if that significant change was attributable to the base closure.

RESEARCH QUESTIONS

The research objectives will be achieved by answering the following research questions:

1. What factors can be identified by analyzing community environmental indicators?
2. What factors changed significantly after the base closed?
3. What occurrences influenced the significantly changed factors?

Chapter 2

LITERATURE REVIEW

This section presents a review of some of the research on the effects of a base closure on a nearby community. It also describes the methodology used and the empirical results thus far obtained in environmental impact research.

OVERVIEW

The research into the environmental impact of base closure upon a nearby community was begun primarily as a result of public concern that was prevalent as installation closings were announced (7:2). "The need to establish exactly how and to what extent communities might feel the impact of closings was then and is clearly important [7:3]."

METHODOLOGIES EMPLOYED

As noted so succinctly by Buckley, "measuring the impact of base closings, ...is a thorny problem [7:8]." Two basic methods of analyzing the impact of base closure have been used: a general case study and an economic base analysis (7:8).

General case studies were supported by the OEA (42; 12). Additionally, several theses on the closure of

Bellefontaine Air Force Station (AFS) and Clinton County AFB employed the general case study format (3; 4; 15; 18; 30; 39). Various techniques within the general case study format included comparative statistics, questionaires, interviews, content analysis, subjective analysis, and graphical analysis (7:9-10; 15; 18).

Economic base analysis, on the other hand, asserted that predictable changes occurred in export and non-export activities when a base closed (7:12). Most notably, Lynch used this methodology (coupled with regression analysis) to construct a model aimed at determining employment multipliers and the impact of base closures upon retail sales, housing, and local government financing (7:17; 28).

General case studies and economic base analyses were the methodologies employed in assessing the impact of base closure, but not the only methods. Input-output analysis, cost benefit analysis, common sense indicators, standard additive methods, adjusted standard additive methods, and factor analysis have also been used.

Input-output (I-O) is a method of quantitatively describing an economy through a system of linear equations. I-O became prominent for expressing environmental impact as a result of the proposed relocation of Hq, AFCS (4; 5; 11; 45).

Cost benefit analysis was briefly mentioned in the literature but has not been implemented to any great extent.

Cost benefit analysis is appealing because it delivers straightforward conclusions but it is limited in the examination of effects on employment and personal income (7:25-26).

Common sense indicators are relatively simple and have good utility. The indicators are not designed to yield quantitative results, but to provide a point of reference to predict a potential problem area (7:26-27).

The standard additive method, adjusted standard additive method, and factor analysis method are all aimed at comparing quality of life variations among communities.

STUDIES CONDUCTED

"In research we seek to know 'what is' in order to explain and predict... [13:24]." This section presents a review of what is important related to the environmental impact of base closure on a nearby community. The following areas will be reviewed: first, economic impact as researched by Lynch; second, economic impact as presented by Diacoff; third, a six part review of economic, physical, and social impact thesis studies; fourth, quality of life indicators as presented by Liu; fifth, another researcher's review of related literature; and sixth, research related to the proposed relocation of Hq, AFCS.

According to Buckley, one of the most complete and most reliable studies was conducted by Lynch (7:17). The study was an investigation of development approaches employed

by the OEA. Specifically, Lynch examined twelve communities located near former military installations: Presque Isle, Maine; Greenville, South Carolina; York, Pennsylvania; Rome, New York; Fort Smith, Arkansas; Edgemont, South Dakota; Mobile, Alabama; Middletown, Pennsylvania; Springfield, Massachusetts; Salina, Kansas; Macon, Georgia; and Roswell, New Mexico. Based on the twelve cases, a composite development strategy was formulated by which a community that is dependent on a nearby base could organize itself to promote its own economic recovery. Of specific interest was Lynch's economic analysis in terms of local employment, retail sales, and residential housing (28:i-xv).

Lynch found that civil service employment was the most important variable in terms of unemployment as a result of base closure. The local employment multipliers among the bases studied exhibited a strong central tendency: a multiplier of 2.58 was found for civilian personnel employed at military bases. A total of 258 jobs were lost in the local community for every 100 civilian jobs lost on the base (28:xiv).

Lynch noted general effects of base closure on retail sales and residential housing. He found that the effect on retail sales was difficult to discern and inconclusive in results (28:322). The residential housing market, on the other hand, was one of the most sensitive economic indicators and "the housing market together with the

local employment levels are the only real measures of actual local economic recovery [28:326]." Lynch summarized other important correlations between the economic environment and a military base; these comments are summarized in the following paragraphs (28:324-326).

Lynch reported that Laben analyzed the direct spending habits of military personnel. He determined that forty percent of the military payroll for Pease AFB, New Hampshire, was spent within a radius of fifteen miles of the base. Most of the military's payroll was spent at the base exchange or commissary; in turn, those functions purchased ten percent and five percent respectively in the local area (25:1-3).

Likewise, Terner found that only twenty-nine percent of the military payroll was spent within the local area (46:49). Three other studies stated that forty-three percent, forty-one percent, and from forty to forty-five percent of the gross military payrolls were actually spent in the local community (8:48; 17:13; 24:213).

Daicoff reported on several economic case studies of community adjustments in response to base closures. The communities studied were: Mobile, Alabama; Salina, Kansas; Bangor, Maine; Brooklyn, New York; Harrisburg, Pennsylvania; Amarillo, Texas; Moses Lake, Washington; Savannah, Georgia; and Joliet, Illinois. His report concentrated strictly on the economic impact of base closure, emphasizing important

factors to analyze and the need to compare data before and after the announcement of a base closure action (12).

Six thesis research efforts, in the form of case studies, examined the economic, physical, and social impacts of base closure on Bellefontaine, Ohio, and on Clinton County, Ohio. In general, these studies not only evaluated the environmental impact of base closure but, more specifically, evaluated which environmental indicators exhibited a high enough degree of association with base closure to be recommended for subsequent research efforts.

Barr and Nardecchia (4) conducted the first economically oriented thesis study in the predictive model building series. The objectives of their research were to determine what recorded data would provide valid estimators of the impact of base closure and which, of that data, should be maintained to provide insight into the impact of base closure (4:17-18).

Their research employed a case study approach. It concentrated primarily on economic indicators validated through prior research efforts. The researchers assumed that all existing data was reliable and that all persons selected for interviews were, in fact, knowledgeable about the economic conditions surrounding base closure. The researchers performed a graphical, subjective analysis of the data, and inferred conclusions from apparent trends (4:23-49). Based on the analysis, the conclusion drawn by the team was "that

Table 2

Economic Indicators-Bellefontaine, Ohio

Residential Construction Permits
Employment
Unemployment
Education
Student Enrollment
School System Revenues
Public Finance
Income Tax Revenues
Payroll
Retail Sales
By Industry
Annual Sales Tax Receipts
Utilities
Garbage Customers
Sanitary Sewer Customers
Water Customers
Electricity Customers

Source: Barr (4)

the overall economic impact on the community of Bellefontaine as a result of the closure of the AFS was negligible [4:50]." Table 2 summarizes the economic indicators used by this research (4:25-49). Parsons (39) employed time series analysis and subjective analysis to evaluate the economic data relating to the closure of Clinton County AFB. His conclusion noted that the data collected was relevant and useful for assessing economic impact at Clinton County. However, based on the negligible impact that evidently occurred, the experience of Clinton County, Ohio, would not

Table 3

Economic Indicators-Clinton County, Ohio

Population
Total Income and Output
Income Distribution
Employment
Regional Economic Stability
Private Capital Formation
Public Capital Formation
Land and Property Values
Public Sector Revenues

Source: Parsons (39)

by itself be sufficient to predict future base closure impacts (39:8,35-39). The importance of this research should not be overlooked since it incorporated a quantitative approach (other than graphical interpretation) in data analysis (3; 4; 15; 18; 30; 39). Table 3 summarizes the economic indicators used by Parsons in his research (39:12).

Barker and Ray (2) studied the physical impact of a base closure on a nearby community. The purpose of their research was to determine what physical environmental factor categories should be evaluated to assess the impact of a base closure (3:9-10). They methodically identified, through a pilot study, ten environmental factor categories and subdivisions. Next, they systematically analyzed the

data content through a random selection and review of 102 articles relevant to the environmental factor categories. As a result of the data analysis they restructured their environmental factor categories into two lists: sources and effects. The sources and effects were subjectively evaluated as indicators of physical impact of an actual base closure. The result was a listing of physical environmental factor categories and subcategories which could be measured at the time of a base closure. This research, however, made no attempt to either quantify or collect data to support the usefulness of the factors identified (3:16-17).

Extending the findings of Barker and Ray, Harris and Beckham measured the physical impact of base closure. The objectives of this research were to measure components of the physical environment before and after base closure, analyze those measurements, and determine if the closure of the base was the cause for any changes in those factors over time (18:11). Harris and Beckham concluded that very little determinable change in the physical environment occurred as a result of base closure based on the indicators which they used. The lack of impact was attributed to the capacity of the physical environment to absorb the base's outputs without being noticed or recorded by the community (18:26). Table 4 summarizes the physical environmental indicators used by Harris and Beckham (18:17-22).

Table 4

Physical Indicators-Bellefontaine, Ohio

Air Quality
Water Quality
Sewage Quality
Radiation
Noise
Housing
Facility Utilization
Transportation
Quality of Service
Quality of Electric Service
Quality of Water Service
Quality of Sewerage Service
Quality of Solids Waste Service

Source: Harris (18)

McDowell and Weber (30) proposed to identify the social impact of base closure. The approach used was a case study of existing data with the intent of establishing a quantitative model. However, the team was not successful in conducting any quantitative tests "because the data collected revealed none of the expected time-series changes of magnitude which seemed sufficient to make a quantitative test meaningful [30:12]." Therefore, McDowell and Weber conducted a graphical analysis on the data collected and concluded:

(1) data to evaluate base closure is generally available; (2) none of the data they collected could validate specific indicators for subsequent research; (3) social impact on Bellefontaine, Ohio, as a result of base closure was insignificant; and (4) no further study of Bellefontaine was warranted (30:91-94). A summary of the social indicators used by this research are combined with those used by Frey into Table 5 (30:44-90).

A case study on Clinton County, Ohio, was completed by Frey (15). Similar to the research by McDowell and Weber, Frey's research attempted to identify those indicators which showed the most promise of being able to demonstrate the social impact of base closure on a nearby community. Specifically, Frey searched for those indicators which reflected long-range effects on quality of life. Additionally, the research dealt only with social indicators that served as measures of objective conditions of society; e.g., births, deaths, crime rate, social disorders (15:9-15). Although historical data and desired information was available, he could not determine the significance of any social impact because of a lack of a quantitative basis of comparison. After analyzing and evaluating all of the factors studied he concluded that the change in any social indicators were not directly attributable to the base closure (15:67-72). Table 5 summarizes the social indicators used (15:31-66).

Liu (27) developed a study to quantitatively assess

Table 5

Social Indicators-Bellefontaine, Ohio
and Clinton County, Ohio

Population
- Annual Population

Employment
- Potential Labor Force
- Unemployment
- On-base Employment Prior to Closure
  - Military Manning
  - Civilian Employees

Welfare
- Aid to Dependent Children
- General Relief
- Medicaid

Judicial
- Common Pleas Court Cases
- Juvenile Court Cases
- Marriages
- Divorces

Education
- Student Enrollment and Dropouts
- Student/Teacher Ratio
- Adult Education Programs

Health
- Births and Deaths
- Illegitimate Births
- New Cases of Venereal Disease
- Mental Health Cases
- Hospital Admissions
- Emergency Room Treatment

Community Services
- Fire Department Responses

Public Utilities
- Electric Customers
- Water Customers
- Telephone Customers

Elections
- Registered Voters
- Number Who Voted

Table 5 (continued)

Municipal Activity
Net City Income Tax
Zoning
Parks and Recreation
Fire Department Alarms and Responses

Source: McDowell (30) and Frey (15)

the urban quality of life in 243 SMSA's throughout the United States. His study developed a systematic methodology for constructing a Quality of Life production model composed of five components and consisting of 123 factors (27:v). He reviewed and considered three methods of indicator construction in his model: the standard additive, the adjusted standard additive, and component and factor analysis. His standard additive method involved generating quality of life indexes from the transformation of data on individual variables into standard scores. His adjusted standard additive method differed slightly from the former approach in that the adjusted method made use of a grade point system, prior to final averaging, in order to avoid extreme values. Last, he considered factor analysis but did not use it throughout the study, commenting:

> Many studies measuring the quality of life in the U.S. found little difference between ranking produced by the standardized additive methods, and by the complicated method of factor and component analyses [27:91].

Based on his quantitative methods Liu was able to reach objective conclusions concerning the quality of life

in specific communities. The methodology Liu used has motivated some of the factors and methodology of the proposed research. Liu noted about his own study: "...it represents a step forward in the social welfare arena because it theoretically developed a conceptual model... [27:223]." Table 6 summarizes the factors used by Liu in his study (27:57,60,64,68,75-77).

Buckley recently presented a factual review of the literature on the effects of a military base on a nearby community and described the methodologies used by researchers and the empirical results thus far obtained (7:1).

Buckley noted that a 1963 study was done by Sasaki on the effects of military installations on the state of Hawaii's total employment. "Sasaki's study provides a useful basis for comparing later attempts to quantify the impact of a military installation [7:15]."

Further, as noted by Buckley, researchers Weiss and Gooding expanded on Sasaki's conclusions. Their study used the locational quotient. The locational quotient was a quantitative expression of the ratio of employees to industry, locally, over employees to industry, nationally. "Location quotients are useful in identifying...and...quantifying employment... [7:16]."

In concluding the review of related research, numerous background studies had been completed by contractors

Table 6

Factors in Liu's Quality of Life Model

- Factors in the Economic Component
  - Individual Economic Well-Being
    - Personal Income Per Capita
  - Community Economic Health
    - Families with Income Above Poverty Level
    - Degree of Economic Concentration
    - Productivity
    - Total Bank Deposits Per Capita
    - Income Inequality Index
    - Unemployment Rate
    - Chamber of Commerce Employees
- Factors in the Political Component
  - Individual Activities
    - Informed Citizenry
    - Presidential Vote Cast
  - Local Government Factors
    - Professionalism
    - Performance
    - Welfare Assistance
- Factors in the Environmental Component
  - Individual and Institutional Environment
    - Air Pollution Index
    - Visual Pollution
    - Noise
    - Solid Waste
    - Water Pollution
  - Natural Environment
    - Climatological Data
    - Recreation Areas and Facilities
- Factors in the Health and Education Component
  - Individual Conditions
    - Health
    - Education
  - Community Conditions
    - Medical Care Available
    - Educational Attainment
- Factors in the Social Component
  - Individual Development
    - Existing Opportunity for Self-support
    - Development of Individual Capabilities
    - Opportunity for Individual Choice

Table 6 (continued)

Individual Equality
Race
Sex
Spatial
Community Living Conditions
General Conditions
Facilities
Other Social Conditions

Source: Liu (27)

for the Air Force because of the proposed relocation of Hq, AFCS. The contractors (e.g., Battelle Laboratories; Benham-Blair-Winesett-Duke, Inc; Hammer, Siler, George Associates; Team Four Inc.; and George L. Crawford and Associates) conducted research under similar purposes. Their analyses addressed the potential socioeconomic impacts of bases upon specific locations (5:I/3). The environmental indicators which the contractors used are important to this research. Table 7 summarizes a typical selection of socioeconomic environmental elements used to assess impact (5:I/1).

Table 7

Socioeconomic Indicators-Air Force Contractors

Demographic
Population
Ethnic/Racial Distribution
Marital Status
Household Composition and Size
Educational Achievement
Income Levels
Occupation by Category

Table 7 (continued)

Economic Characteristics	
	Definition of Region
	Employment
	Public Finance
	Base Procurement
	Housing
	Summary of Regions Economy
	Education
	Medical
	Community Services and Facilities

Source: Battelle (5)

Chapter 3

METHODOLOGY AND ANALYSIS

The purpose of this research was to develop and identify factors which explain variations in the environment of a community as a result of base closure. Basic concepts and community impact issues were discussed in the previous chapters. This chapter describes the methodology and analysis used to assess the impact of the closure of Laredo AFB upon the community of Laredo. Specifically, this chapter includes: how the environmental factors are derived, the analysis of those factors to determine if there was an impact, and then, the determination of whether that impact was attributable to base closure.

Methodology and analysis were combined within this chapter primarily because of the use of factor analysis as a data reduction technique. Because of the subjective assessments required as a part of factor analysis, the researchers believed it was more prudent to explain the methodology employed as the analysis progressed.

A variety of techniques have been employed to evaluate the impact of base closures on a nearby community. However, research should add to a body of knowledge and should attempt to transform existing knowledge into a more useable form; it should not be completely duplicative of

previous research. Also, sufficient prior research had not been accomplished in the field of environmental impact of base closure to render one standard technique more valid than any other (44).

Thus far, research concerning the impact of base closure on a nearby community had considered the environment as composed of components. As succinctly demonstrated earlier in this research in Figure 1, the environment was typically envisioned as three components: economic, physical, and social. This research concurs with the basic philosophy of the tri-component model but adds the important dimension that: each indicator within each factor within each component is inter related with all other indicators to some extent. The extent of inter relationship can be measured, hence, the analysis of the impact on a nearby community can be dealt with on the environmental factor level vice the individual environmental indicator level.

The principle objective of the methodology employed in this research was to obtain an efficient description of the observed data. This aim should not be construed to mean an attempt to discover the "fundamental" or "basic" categories of environmental impact of base closure. It would have been desirable to base the analysis upon a set of indicators which measured all possible environmental impacts of a given population as completely and accurately as possible. However, even in such a case, the indicators would

not have been completely fundamental because of the omission of important measures which had not yet been devised. While the goal of complete description could not theoretically be reached, it could be approached practically in a limited field of research where a relatively small number of indicators was considered exhaustive. Therefore, the methodology employed gave a simple interpretation of a given body of data and thus afforded a fundamental description of the particular set of environmental indicators analyzed (16).

The primary emphasis employed in this methodology evolved around the use of factor analysis as a data reduction technique. The chief value of factor analysis was "to supplement, and perhaps simplify, conventional statistical techniques and computations [16:7]." This application was used to expedite a time-series analysis. The savings was especially noticeable because there were a large number of indicators which reduced to a small number of factors. Factor analysis provided an improved method of obtaining more reliable and valid pools of subsets (16:7).

DATA COLLECTION PLAN

The data collection scheme was directed toward secondary data collection; that which had been gathered before (13:177). Data was initially collected in the form of calendar year and fiscal year totals for all years

between 1960 and 1975 for the community of Laredo, Texas. The original data was not purported to be an exhaustive enumeration of all potential environmental indicators. The environmental indicators were selected because they were frequently identified as meaningful indicators of community conditions, and because they could be obtained within the existing time constraints. The data collected was interval or better in level of measurement.

The initial data collection process began with personal interviews of local officials to determine sources of data for the environmental indicators. A listing of officials who were interviewed is provided in Appendix D. Data that was not available in conjunction with the interviews was requested by letter or obtained by library research, as appropriate.

Once collected, the data were adjusted to reflect fiscal year totals to form a common base. All data were not available continuously for all fiscal years between 1960 and 1975. Hence, in order to perform a logical factor analysis and time-series analysis the initial data year was selected as 1965. Any missing values were graphically interpolated and those indicators which were believed to have been unreasonably biased by interpolation were excluded from further analysis. The resultant indicators, those listed in Table 8, contained continuous values from 1965 to 1975. The subsequent analysis of the data was subject to the following.

Table 8

Environmental Indicators

Indicator	Title
S01	Number of Building Permits Issued
S02	Dollar Value of Building Permits Issued
S03	Total Bank Deposits
S04	Taxes, Assessed Valuation
S05	Tax Rate
S06	Civic Center and Swimming Pool Expenditures
S07	Fire Protection Employees
S08	General Government Expenditures
S09	Health and Hospital Expenditures
S10	Local Media
S11	Miles of Storm Sewers
S12	Miles of Sanitary Sewers
S13	Miles of Graded Streets
S14	Miles of Paved Streets
S15	Full Time Municipal Employees
S16	Part Time Municipal Employees
S17	Number of Registered Voters
S18	Percent Voting in Presidential Elections
S19	Public Safety Expenditures
S20	Public Welfare Expenditures
S21	Dollars of Retail Sales
S22	Sanitation Expenditures
S23	Number of Street Lights
S24	Unemployment Rate
S25	Department of Agriculture Outlays
S26	Department of Commerce Outlays
S27	DOD Civilian Pay
S28	DOD Military Active Duty Pay
S29	DOD Reserve and National Guard Pay
S30	DOD Military Retired Pay
S31	DOD Prime Supply Contracts, Value
S32	DOD Prime Service Contracts, Value
S33	DOD Prime Construction Contracts, Value
S34	DOD Contracts Less Than $10,000, Value
S35	Department of Health, Education, and Welfare Outlays
S36	Department of Housing and Urban Development Outlays
S37	Department of Labor Outlays
S38	Number of Students Registered
S39	Student Teacher Ratio

Table 8 (continued)

Indicator	Title
S40	Water Quality, Coliform Increase
S41	Water Quality, Bacteria Increase
S42	Number of Fire Hydrants
S43	Department of Transportation Outlays
S44	Civil Service Expenditures
S45	General Services Administration Expenditures
S46	Office of Economic Opportunity Expenditures
S47	Small Business Administration Expenditures
S48	Total Federal Outlays, Webb County
S49	Total Federal Outlays, Laredo
S50	Population, Laredo
S51	Total Housing Construction Permits Issued
S52	Single-Unit Housing Construction Permits Issued
S53	Five or More-Unit Housing Construction Permits Issued
S54	Drug Arrests
S55	Total Volumes in City Library
S56	Number of Doctors' Offices
S57	Number of Doctors' Employees
S58	Number of Taverns and Restaurants
S59	Number of Tavern and Restaurant Employees
S60	Number of Auto Dealers and Service Stations
S61	Number of Auto Dealer and Service Station Employees
S62	Number of General Merchandise Employees
S63	Number of General Merchandise Retail Stores
S64	Labor Force
S65	Total Bank Assets
S66	Number of Wholesale Grocery Companies
S67	Number of Wholesale Grocery Employees
S68	Number of Trucking and Warehousing Companies
S69	Number of Trucking and Warehousing Employees
S70	Number of Urban Passenger Transport Employees
S71	Savings and Loan, Total Assets
S72	Motor Vehicle Registrations
S73	Telephone Connections
S74	Electrical Connections
S75	Gas Connections
S76	Water Connections
S77	Students at Laredo Junior College
S78	Graduate Education Division Students at Laredo Junior College
S79	Total Police Hours Expended
S80	Total Police Assigned
S81	Percent Manned, Laredo Police Force

Table 8 (continued)

Indicator	Title
S82	Total Traffic Accidents
S83	Total Guilty of Traffic Violations
S84	Total Arrests for Criminal Activity
S85	Dollars of Exports
S86	Dollars of Imports

Source: See Appendix C.

ASSUMPTIONS

1. All secondary data accumulated for the research was, in fact, accurate.
2. The data acquired for the environmental indicators were representative of the community of Laredo.
3. Trends observed in the data would have continued unabated had the base not closed.
4. The officials who were interviewed were, in fact, knowledgeable about the circumstances and conditions surrounding the base closure.
5. Every indicator collected was, to some extent, inter related with all other indicators.
6. The environmental impact could not be conveniently divided into independent factors; every indicator had some inter related effect on the total community environment.

DATA ANALYSIS

The data was analyzed using factor analysis,

time-series analysis, and subjective analysis. Appropriate definitions and a general discussion of the techniques employed in factor analysis and time-series analysis are provided in Appendix A and Appendix B, respectively.

Factor Analysis

To effectively use factor analysis to reduce the set of environmental indicators, a logical and rigorous procedure was followed. From a generalized perspective, this procedure consisted of determining the reduced number of factors which describe the environment, obtaining a final rotated factor matrix, evaluating this matrix, devising logical criteria for the indicators in each factor, and finally, identifying each factor based upon a subjective evaluation of the indicators contained in that factor. Once this procedure was completed the resultant environmental factor was considered as a new variable and assessed by time-series analysis and subjective analysis.

The first step, determining the number of factors to be included, was accomplished by use of subprogram FACTOR of the Statistical Package for the Social Sciences (SPSS) on the Computational Resources for Engineering and Simulation Training and Education (CREATE) computer system. The result of the first step was an analysis of the eigenvalue for each factor. The eigenvalue is the sum of the proportion of the variance of each indicator that is accounted for by that factor.

> A practical basis for finding the number of common factors that are necessary, reliable, and meaningful... is that the number of common factors should be equal to the number of eigenvalues greater than one... [16:363].

The initial results indicated that eight factors had eigenvalues greater than one. The first eight factors also explained 99.1 percent of the variation of the original eighty-six environmental indicators. The first ten factors (the initial eight plus the next two) accounted for 100 percent of the variation of the original 86 environmental indicators. The first ten factors are listed in Table 9.

Table 9

Eigenvalues and Percent of Explained Variation

Factor	Eigenvalue	Percent of Explained Variation	Cumulative Percent
1	53.47	62.2	62.2
2	13.05	15.2	77.4
3	6.11	7.1	84.5
4	3.95	4.6	89.1
5	3.34	3.9	93.0
6	2.64	3.1	96.1
7	1.49	1.7	97.8
8	1.14	1.3	99.1
9	0.62	0.7	99.8
10	0.18	0.2	100.0

The final rotated factor matrix was then obtained via SPSS, using orthogonal principal component factor analysis and the varimax option as shown in the sample program contained in Appendix G. This matrix, representing

the correlation coefficients between the indicators and the factors, is included in Appendix E. These correlation coefficients indicate the importance of any given indicator in determining a factor, and are commonly referred to as "loadings [34:475]." Additionally, these loadings indicate the importance of any given factor in explaining an indicator and the square of the loading for any given factor is the proportion of the variance in that indicator accounted for by that factor (34:475).

Having obtained the factor matrix, loading criteria were then developed for each factor to determine which indicators would be considered for inclusion in which factor. All indicator loadings were inspected to determine which factor each indicator loaded highest on (i.e., which column loaded highest in each row), second highest, third highest, and so forth, down to 0.3000.* Based on the pattern of loading revealed by ranking the factor loading of each indicator, cutoffs were established within each factor and these cutoffs then became the loading criteria for determining which indicators would be included in which factor. The objective of the loading criteria was to ensure

---

*Since the square of the loading is the proportion of indicator variance accounted for by a factor, a loading of .3000 represents 9% of the variation in the indicator. The researchers believed that a loading less than .3000 would not be significant for the purpose of this study.

that sufficient meaningful indicators would be included to enable factor identification without including so many indicators that potentially significant relationships would be obscured. Further, to reduce spurious relationships to a minimum, the researchers selected a very conservative minimum loading criteria of 0.5000. The factor loading criteria thus established are as shown in Table 10.

Table 10

Factor Loading Criteria

Factor Number	Loading Criteria
1	0.7000
2	0.6500
3	0.6000
4	0.5500
5	0.5000
6	0.5000
7	0.5000
8	0.5000

Based on the loading criteria, it was evident that some indicators, although loading greater than 0.3000 on a number of factors, would not be included in any factor. These indicators were considered to be complex. For example, if an indicator loaded on three factors, it would be said to have a factorial complexity of three (34:475). Although the variation in these complex indicators is still accounted for by the factors, the indicators were not included in any specific factor for the purpose of

identifying that factor. These complex indicators are listed in Table 11.

Table 11

Complex Indicators

Indicator	Label
S02	Dollar Value of Building Permits Issued
S16	Part Time Municipal Employees
S40	Water Quality, Coliform Increase
S43	Department of Transportation Outlays
S49	Total Federal Outlays, Laredo
S63	General Merchandise Stores

The remaining indicators were then assigned to each factor based upon the respective loading criteria.

Factor 1. The first factor produced by using varimax rotation for principal component analysis is designed to be that factor which explains more of the variance in the indicators than any other factor. In this case, Factor 1 accounted for 62.2 percent of the variation in the 86 indicators. Of the 86 indicators, 53 loaded highest on Factor 1. Of these 53 indicators, 44 met the loading criteria for Factor 1 and are as listed in Table 12.

Of the 44 indicators assigned to Factor 1, most were of a type that would experience a steady growth due to normal population increase, inflation, and expansion.

Table 12

Factor 1 Indicators

Indicator	Loading	Label
S01	.75482	Number of Building Permits Issued
S03	.70048	Total Bank Deposits
S04	.96976	Taxes, Assessed Valuation
S05	-.98657	Tax Rate
S06	.89455	Civil Center & Swimming Pool Expenditures
S08	.80685	General Government Expenditures
S09	.85963	Health and Hospital Expenditures
S12	.75937	Miles of Sanitary Sewers
S13	.96937	Miles of Graded Streets
S14	.90873	Miles of Paved Streets
S15	.82789	Full Time Municipal Employees
S17	.89750	Number of Registered Voters
S18	-.89656	Percent Voting in Presidential Elections
S19	.87193	Public Safety Expenditures
S20	.85792	Public Welfare Expenditures
S21	.84013	Dollars of Retail Sales
S22	.79735	Sanitation Expenditures
S23	.97363	Number of Street Lights
S29	.93946	DOD Reserve and National Guard Pay
S30	.77153	DOD Military Retired Pay
S33	-.94521	DOD Prime Construction Contracts, Value
S35	.82227	Department of Health, Education, and Welfare
S37	.78620	Department of Labor Outlays
S38	.96736	Number of Students Registered
S42	.82455	Number of Fire Hydrants
S44	.73229	Civil Service Expenditures
S48	.80746	Total Federal Outlays, Webb County
S50	.92850	Population, Laredo
S55	.90752	Total Volumes in City Library
S56	.90902	Number of Doctors' Offices
S57	.76047	Number of Doctors' Employees
S62	.77158	Number of General Merchandise Employees
S65	.76485	Total Bank Assets
S70	-.71964	Number of Urban Passenger Transport Employees
S71	.87385	Savings and Loan, Total Assets
S72	.88875	Motor Vehicle Registrations
S73	.95908	Telephone Connections
S74	.91371	Electrical Connections

Table 12 (continued)

Indicator	Loading	Label
S75	.79841	Gas Connections
S76	.91366	Water Connections
S78	.71981	Graduate Education Division Students at Laredo Junior College
S79	.71981	Total Police Hours Expended
S84	.87857	Total Arrests for Criminal Activity
S86	.72028	Dollars of Imports

Those indicators closely linked to population, for example, included:

S17	Number of Registered Voters
S21	Dollars of Retail Sales
S38	Number of Students Registered
S50	Population, Laredo
S72	Motor Vehicle Registrations
S73	Telephone Connections
S74	Electrical Connections
S75	Gas Connections
S76	Water Connections
S78	Graduate Education Division Students at Laredo Junior College
S84	Total Arrests for Criminal Activity

These indicators would all tend to increase as the population grows. Other indicators assigned to this factor would also tend to increase due to a combination of more people, more money to invest, more cost for public services, or inflation (higher cost). These indicators were:

S03	Total Bank Deposits
S06	Civic Center & Swimming Pool Expenditures
S08	General Government Expenditures
S09	Health and Hospital Expenditures
S19	Public Safety Expenditures
S20	Public Welfare Expenditures
S22	Sanitation Expenditures

S29	DOD Reserve and National Guard Pay
S30	DOD Military Retired Pay
S35	Department of Health, Education, and Welfare
S37	Department of Labor Outlays
S44	Civil Service Expenditures
S48	Total Federal Outlays, Webb County
S65	Total Bank Assets
S71	Savings and Loan, Total Assets
S86	Dollars of Imports

Also, there were indicators which would be expected to increase as the city grows to accommodate the growing population. These indicators included:

S01	Number of Building Permits Issued
S04	Taxes, Assessed Valuation
S12	Miles of Sanitary Sewers
S13	Miles of Graded Streets
S14	Miles of Paved Streets
S15	Full Time Municipal Employees
S23	Number of Street Lights
S42	Number of Fire Hydrants
S55	Total Volumes in City Library
S56	Number of Doctors' Offices
S57	Number of Doctors' Employees
S62	Number of General Merchandise Employees
S79	Total Police Hours Expended

The common link that related 40 of the 44 indicators loading on this factor was growth. Henceforth, Factor 1 will be considered and referred to as the Growth Factor.

Factor 2. The second factor produced by principal component factor analysis attempts to account for the maximum amount of the variation in the indicators that was not previously accounted for by the first factor. As such, Factor 2 accounted for 15.2 percent of the remaining variation in the 86 indicators (cumulative percentage of explained variation--77.3). Of the 86 indicators, 17 loaded highest

on this factor. Of these, 16 met the loading criteria for Factor 2 and are listed in Table 13.

Table 13

Factor 2 Indicators

Indicator	Loading	Label
S11	.79776	Miles of Storm Sewers
S24	.68288	Unemployment Rate
S25	.71573	Department of Agriculture Outlays
S27	-.98033	DOD Civilian Pay
S28	-.94770	DOD Military Active Duty Pay
S32	-.90782	DOD Prime Service Contracts, Value
S34	-.95665	DOD Contracts Less Than $10,000, Value
S46	-.71336	Office of Economic Opportunity Expenditures
S53	-.66432	Five or More-Unit Housing Construction Permits Issued
S54	.87367	Drug Arrests
S58	.90884	Number of Taverns and Restaurants
S59	.85959	Number of Tavern and Restaurant Employees
S60	.81266	Number of Auto Dealers and Service Stations
S61	.73152	Number of Auto Dealer and Service Station Employees
S82	.68527	Total Traffic Accidents
S85	.73223	Dollars of Exports

Initially, the 16 indicators which loaded on Factor 2 did not appear related. However, many of the indicators did appear to be in the same category as most of the indicators which loaded on the Growth Factor. That is, they appeared to be the type of indicator that was related to growth in cost, the number of people, or the size of the city. The indicators in which this tendency was most

expected were:

S11	Miles of Storm Sewers
S53	Five or More-Unit Housing Construction Permits
S58	Number of Taverns and Restaurants
S59	Number of Tavern and Restaurant Employees
S60	Number of Auto Dealers and Service Stations
S61	Number of Auto Dealer and Service Station Employees

But, these indicators did not load on the Growth Factor. That these indicators did not load on the Growth Factor must indicate that a substantial change in the rate of variation occurred in the indicators. Further, other indicators which loaded on this factor were classified as extrinsic. That is, indicators which varied due to decisions made or actions taken outside Laredo. These indicators included:

S25	Department of Agriculture Outlays
S27	DOD Civilian Pay
S28	DOD Military Active Duty Pay
S32	DOD Prime Service Contracts, Value
S34	DOD Contracts Less Than $10,000, Value
S46	Office of Economic Opportunity Expenditures

These extrinsic indicators would also tend to increase (due to the pressure of inflation, if nothing else) unless affected by a substantial change. Therefore, the underlying commonality in these indicators was the substantial change which occurred in their rate of variation, generally due to externalities. Henceforth, Factor 2 will be considered and referred to as the Extrinsic Factor.

Factor 3. As principal component factor analysis proceeds,

each subsequent factor accounts for progressively less of the variance in the indicators. Hence, Factor 3 accounted for 7.1 percent of the remaining variation in the indicators (cumulative percentage of explained variation--84.5). Of the 86 indicators, 8 loaded highest on this factor. In all, 10 indicators met the loading criteria for Factor 3 and are listed in Table 14.

Table 14

Factor 3 Indicators

Indicator	Loading	Label
S10	.62939	Local Media
S39	-.69505	Student Teacher Ratio
S47	.76276	Small Business Administration Expenditures
S64	-.67750	Labor Force
S66	-.73204	Number of Wholesale Grocery Companies
S68	.67358	Number of Trucking & Warehousing Companies
S69	.68630	Number of Trucking & Warehousing Employees
S77	.60876	Students at Laredo Junior College
S80	-.65950	Total Police Assigned
S81	-.68033	Percent Manned, Laredo Police Force

Again, certain of the indicators which loaded on Factor 3 appeared to be of the type which would demonstrate an increase commensurate with population growth and inflation. These indicators were:

S10 Local Media
S39 Student Teacher Ratio
S80 Total Police Assigned
S81 Percent Manned, Laredo Police Force

Both the growth type indicators and the intrinsic indicators could be expected to vary with population and city size. Therefore, change in the rate of variation was again the common bond that related these indicators. However, due to the inclusion of intrinsic indicators, this factor will be considered and referred to as the Intrinsic Factor.

Factor 4. Continuing with the trend of explaining progressively less variance in the total of indicator variance with each subsequent factor, Factor 4 explains 4.6 percent of that variance (cumulative percentage of explained variation--89.0). Two of the 86 indicators loaded highest on this factor. Only these 2 indicators met the loading criteria for Factor 4 and are as listed in Table 15.

Table 15

Indicators for Factors 4 Through 8

Factor	Indicator	Loading	Label
4	S31	-.95621	DOD Prime Supply Contracts, Value
	S52	.61112	Single-Unit Housing Construction Permits Issued
5	S41	-.95959	Water Quality, Bacteria Increase
6	S26	.56440	Department of Commerce Outlays
	S83	.90098	Total Guilty of Traffic Violations
7	S07	-.54907	Fire Protection Employees
	S36	.57956	Department of Housing & Urban Development Outlays
8	S45	-.94529	General Services Administration Expenditures

At this point, identifying the factors by the relationship between the included indicators is no longer meaningful because of the paucity of indicators loading on this and each subsequent factor. Therefore, Factors 4 through 8 are identified only by the factor number.

Factor 5. This factor explained 3.9 percent of the total variation in the 86 indicators (cumulative percentage of explained variation--92.9). One indicator loaded highest on this factor, met the loading criteria for Factor 5, and is as listed in Table 15.

Factor 6. This factor explained 3.1 percent of the total variation (cumulative percentage of explained variation--96.0). One indicator loaded highest on this factor, and one additional indicator met the loading criteria for Factor 6. These two indicators are as listed in Table 15.

Factor 7. This factor explained 1.7 percent of the total variation (cumulative percentage of explained variation--97.7). One indicator loaded highest on this factor, and one additional indicator met the loading criteria for Factor 7. These two indicators are as listed in Table 15.

Factor 8. This factor explained 1.3 percent of the total variation (cumulative percentage of explained variation--99.1). One indicator loaded highest on this factor, met the loading criteria for Factor 8, and is as listed in

Table 15.

These eight factors constitute the variables to be further analyzed. The first three factors, accounting cumulatively for 84.5 percent of the variation in the indicators, will be referred to as the major factors, while the remaining five factors will be referred to as the minor factors.

The individual variable values within the factors are the factor scores provided by SPSS. These factor scores are composite indices constructed by multiplying the factor loading by the standardized value of each indicator and summing, for each year, for each factor. These factor scores are contained in Appendix H.

Time-Series Analysis

For the purpose of this research, time-series analysis was used to extrapolate the factor scores prior to base closure to discrete periods one and two years after base closure. In general, the procedure consisted of determining the optimum α-level and order of smoothing, determining whether time-series forecasting was appropriate, calculating the mean average deviation (MAD) error, constructing confidence intervals about the predicted values, and comparing the actual factor scores with the predicted scores as a prelude to subjective analysis.

The first step, determining the optimum α-level and order of smoothing for each factor score and lead time,

was accomplished via the TCAST Program (21), as explained in Appendix B. The optimum α-level and order of smoothing for a specified factor and lead time comprised the forecast model for that factor. The resulting forecast models are as listed in Table 16.

Table 16

TCAST Forecast Models

Factor Number	Lead Time	Optimum α-Level	Optimum Smoothing Order
1	1	.305	2
	2	.200	3
2	1	.500	2
	2	.510	2
3	1	.449	2
	2	.449	2
4	1	.001	1
	2	.001	1
5	1	.600	1
	2	.700	2
6	1	.001	1
	2	.001	1
7	1	.300	1
	2	.100	1
8	1	.020	3
	2	.040	1

These results were evaluated to determine the appropriateness of the TCAST selected forecast model.

Criteria for determining the appropriateness were developed by considering the effect of an α-level on a data series, and by considering what an order of smoothing actually represents. The α-level determines the relative importance of previous data in computing the appropriate forecast. High values of α could have resulted in forecasts based primarily on the few most recent values. To be considered prudent, the maximum value of α could not exceed the quantity (lead time/lead time + 1) for any forecast model (21:3-5). Therefore, any factor for which an optimum forecast model α-level exceeded 0.500 for a lead time of one or 0.667 for a lead time of two, was analyzed subjectively.

Further, the optimum order of smoothing was realistically evaluated. First-order smoothing represents data which is relatively constant over time; graphically--a horizontal line (21:3-5). Second-order smoothing provides a good representation of linear data, while third-order smoothing represents data which varies quadratically (21:3-5). The researchers believed that first-order smoothing was not sensitive enough to reflect changes in the data base in a way that would provide substantive information; therefore, any factor with an optimum smoothing order of one was analyzed subjectively.

The major factors met the criteria for evaluation via time-series analysis, while the remaining minor factors (cumulative percentage of explained variation--14.6) were

evaluated subjectively. Therefore, the predicted factor scores and MAD error were calculated for the major factors, and confidence intervals were constructed as follows.

Growth Factor. The predicted factor scores for the Growth Factor were computed using the formulations contained in Appendix B for the optimum forecast models for lead time equal to one and lead time equal to two. The actual factor scores, the predicted factor scores, and the difference between the actual and predicted scores (designated as the error) for both optimum forecast models are as shown in Table 17. The MAD for each forecast model was then computed as the average error for each model. Confidence intervals were then constructed using a safety factor of 2.062, which represents a 90 percent probability of the actual values being contained within the confidence interval if no change occurred in the factor score trend (21:3-6). The confidence interval is then equal to the predicted value ± the safety factor times the MAD. The range of the confidence interval for a lead time of one was from 0.449 to 1.896. The range of the confidence interval for a lead time of two was from -0.1927 to 3.2587. A graphical representation of the actual factor scores, the predicted factor scores for lead time equal to one, and the confidence intervals for lead time equal to one and two are presented in Chart 1. Both actual factor scores were within the predicted confidence interval.

Table 17

Time-Series Analysis--Growth Factor

Year	Actual Factor Score (rounded)	Lead Time = 1, Type 2, α = .305		Lead Time = 2, Type 3, α = .200	
		Predicted Value	Error	Predicted Value	Error
1965	-1.622	-	-	-	-
1966	-1.468	-	-	-	-
1967	-1.287	-1.313	0.026	-	-
1968	-0.229	-1.143	0.914	-1.003	0.774
1969	0.165	-0.429	0.594	-0.812	0.977
1970	0.488	0.175	0.313	-0.667	1.155
1971	0.776	0.663	0.113	0.076	0.700
1972	0.604	1.058	0.454	1.161	0.558
1973	0.725	1.117	0.392	1.585	0.859
1974	0.777	1.172	-	-	-
1975	1.071	-	-	1.539	-

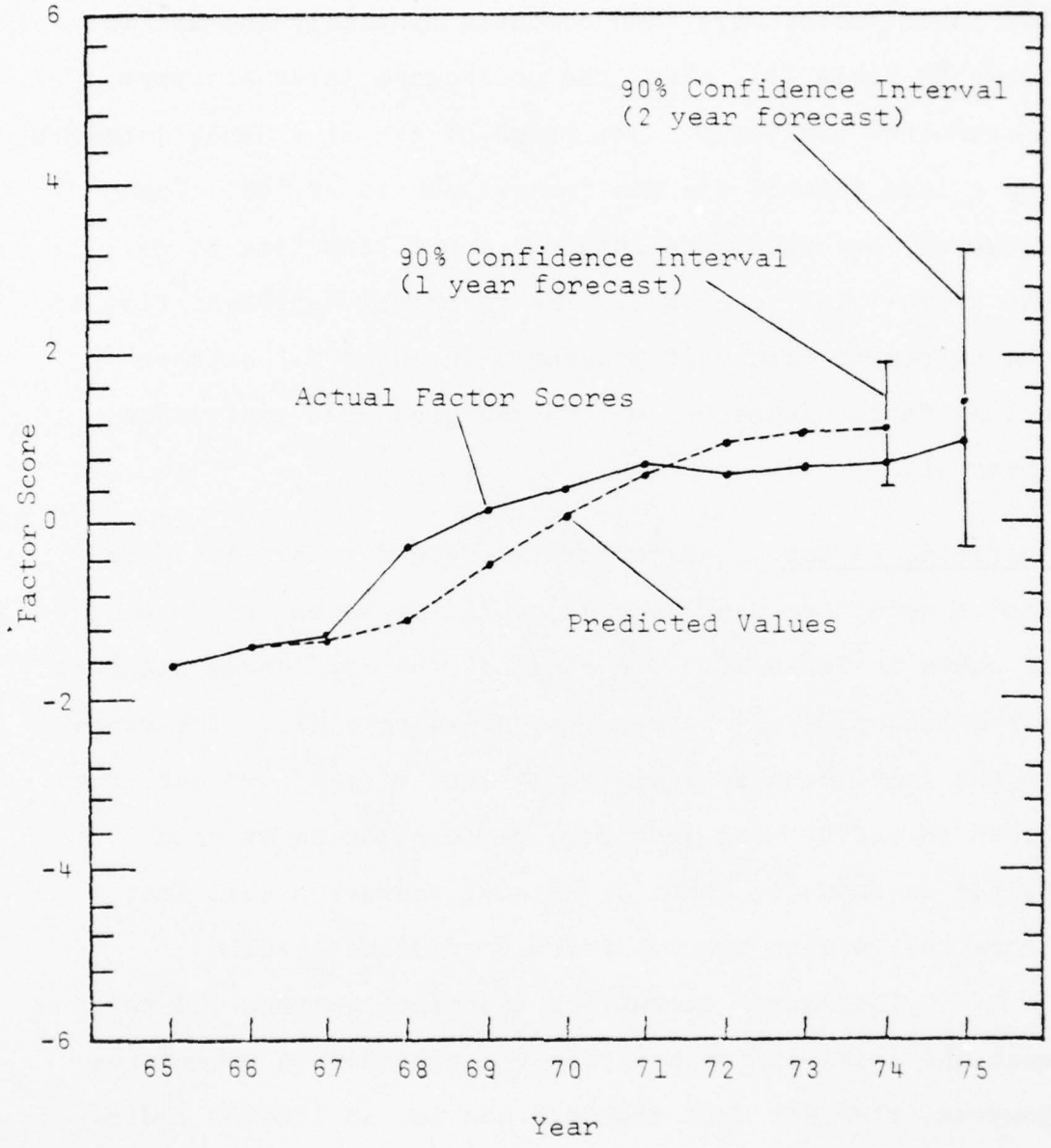


Chart 1

Growth Factor

Extrinsic Factor. The predicted factor scores for the Extrinsic Factor were then computed similarly and are as shown in Table 18. Also, the confidence intervals were constructed similarly. The range of the confidence interval for a lead time of one was from -1.494 to -0.780. The range of the confidence interval for a lead time of two was from -1.861 to -0.659. The graphical representation of the Extrinsic Factor is presented in Chart 2. Neither actual factor score was within the predicted confidence interval.

Intrinsic Factor. The forecast models for the Intrinsic Factor were then used to predict factor scores with results as shown in Table 19. The range of the confidence interval for a lead time of one was from 0.644 to 4.031. The range of the confidence interval for a lead time of two was from 0.664 to 5.288. The graphical representation of this factor is shown in Chart 3. Again, neither actual factor score fell within the predicted confidence level.

The factor scores for the minor factors did not meet the criteria for analysis via time-series procedures. However, the fact that they did not is, in itself, indicative of a lack of trend within these factors. A graphical representation of the minor factors is provided in Chart 4 to aid in subsequent subjective analysis.

Table 18

Time-Series Analysis--Extrinsic Factor

Year	Actual Factor Score (rounded)	Lead Time = 1, Type 2, α = .500		Lead Time = 2, Type 2, α = .510	
		Predicted Value	Error	Predicted Value	Error
1965	0.309	-	-	-	-
1966	0.261	-	-	-	-
1967	0.093	0.212	0.119	-	-
1968	-0.340	0.044	0.384	0.163	0.503
1969	-0.419	-0.419	0.000	-0.034	0.385
1970	-0.540	-0.593	0.053	-0.593	0.053
1971	-1.052	-0.715	0.337	-0.768	0.284
1972	-0.908	-1.213	0.305	-0.876	0.032
1973	-0.968	-1.154	0.186	-1.459	0.491
1974	1.673	-1.137	-	-	-
1975	1.892	-	-	-1.260	-

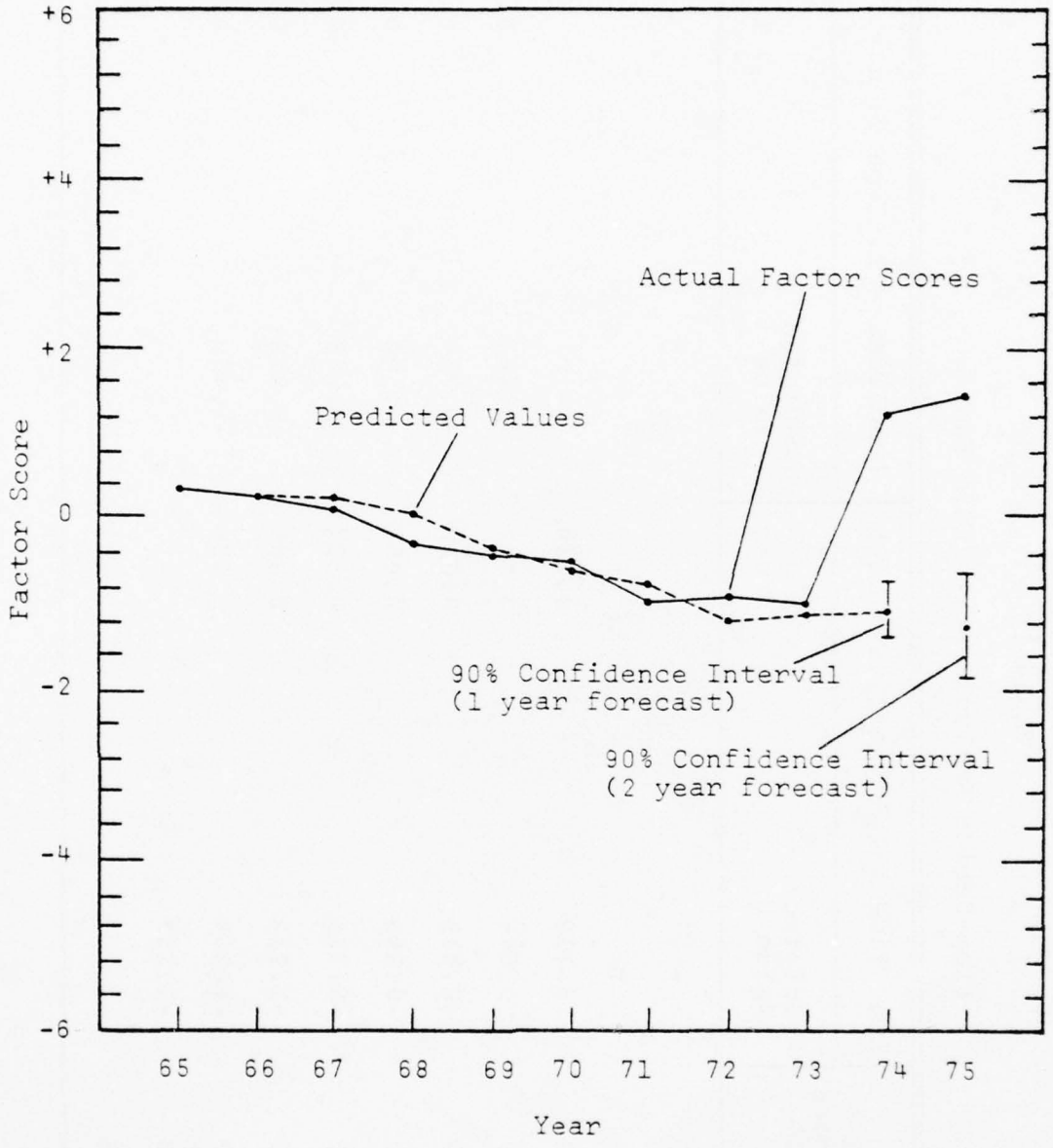


Chart 2

Extrinsic Factor

Table 19

Time-Series Analysis--Intrinsic Factor

Year	Actual Factor Score (rounded)	Lead Time = 1, Type 2, α = .449		Lead Time = 1, Type 2, α = .449	
		Predicted Value	Error	Predicted Value	Error
1965	0.073	-	-	-	-
1966	0.285	-	-	-	-
1967	0.396	0.496	0.100	-	-
1968	-0.840	0.618	1.458	0.707	1.547
1969	-1.068	-0.503	0.565	0.809	1.877
1970	-1.223	-1.115	0.108	-0.607	0.616
1971	-0.553	-1.430	0.877	-1.334	0.781
1972	0.236	-0.881	1.117	-1.670	1.906
1973	2.408	0.062	2.346	-0.943	3.351
1974	0.469	2.337	-	-	-
1975	-0.184	-	-	-	-

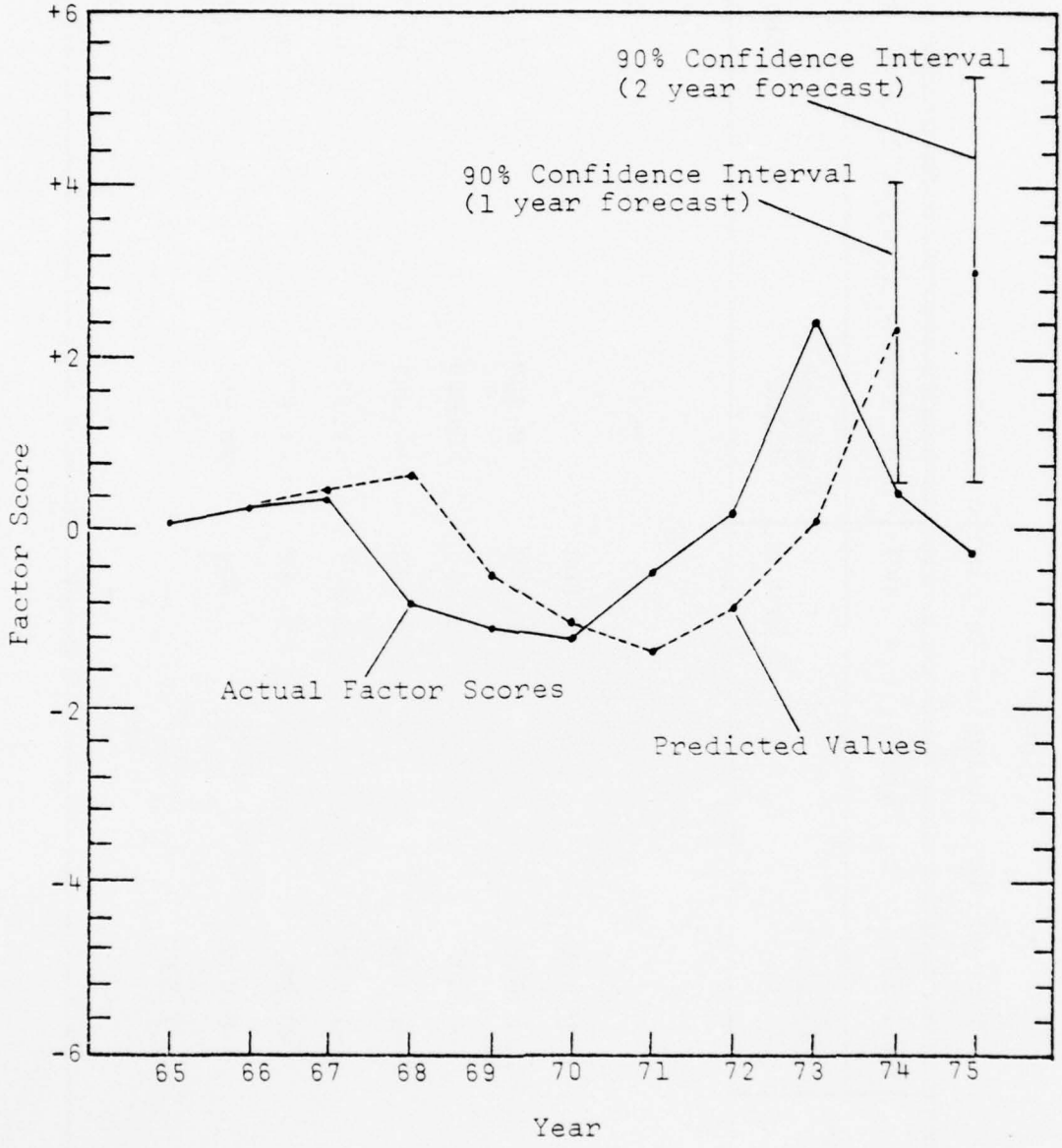


Chart 3

Intrinsic Factor

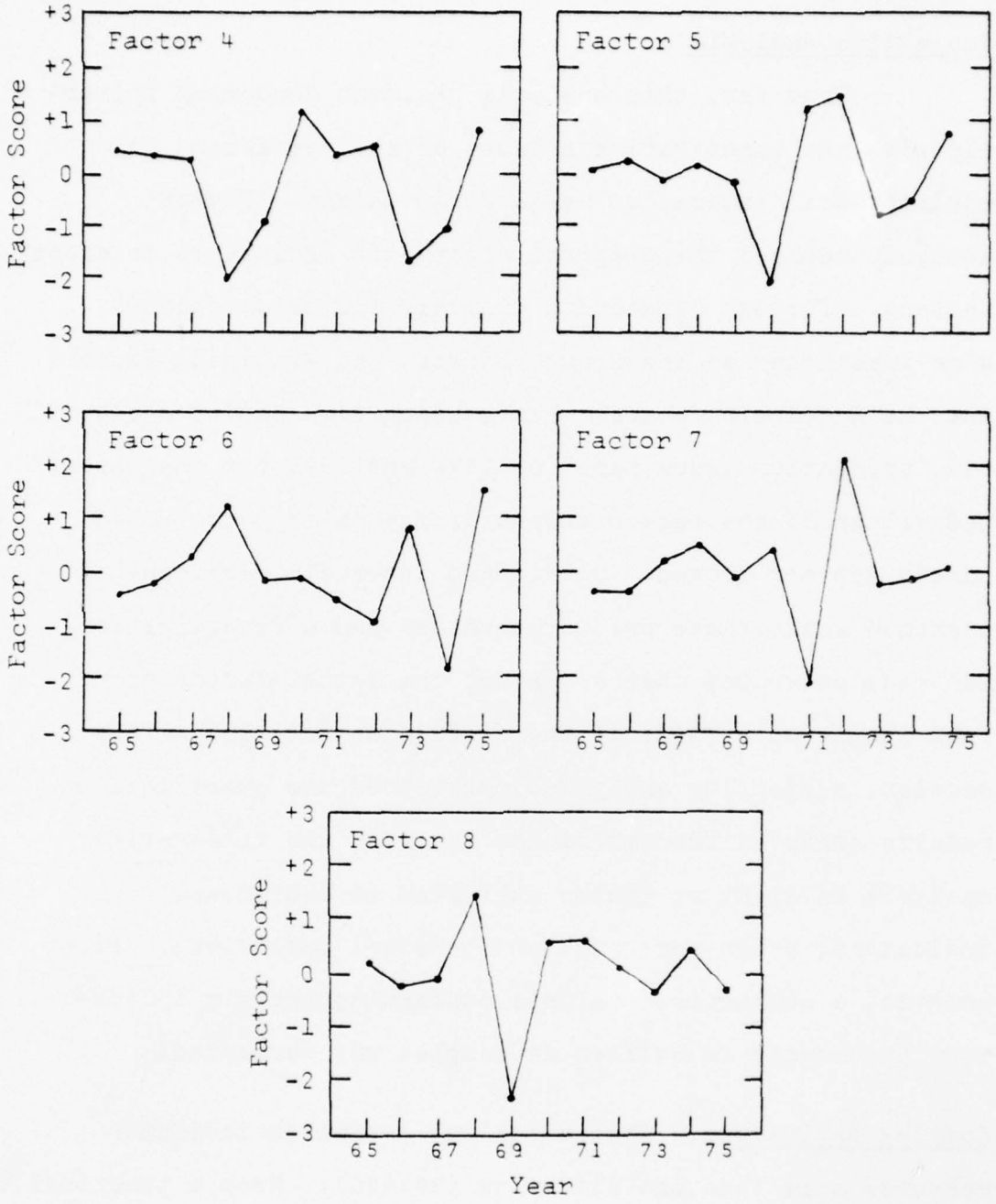


Chart 4

Factors 4 through 8

Subjective Analysis

Thus far, this analysis has been concerned primarily with the quantitative aspects of the variations in environmental indicators measured in Laredo. Factor analysis reduced the original eighty-six indicators to eight factors. Through subsequent analysis the major factors were identified as the Growth Factor, the Extrinsic Factor, and the Intrinsic Factor. Next, using time series analysis, predictions were made for 1974 and 1975 for the expected values of the factor scores of the major factors had Laredo AFB not closed. Confidence intervals were constructed about those predicted values and a determination was made regarding whether or not the actual factor score fell inside or outside of the confidence interval. This section, subjective analysis, considered the quantitative results achieved through factor analysis and time-series analysis in light of trends exhibited in individual indicators, prior research, and personal interviews. First, however, a subjective analysis concerning the six indicators previously identified as complex was warranted.

Complex indicators. Theoretically, a complex indicator measures more than one dimension (34:475). From a practical standpoint this research considered the complex indicators as representative of random or unexplained influences. That is, their variation could not be attributed to a known or previously hypothesized cause such as population growth

or inflation rate. The subsequent discussion refers to trends subjectively analyzed using the individual indicator charts contained in Appendix F.

The first complex indicator was S02, Dollar Value of Building Permits Issued. It might normally be expected that this indicator would vary in accord with the number of building permits issued. Hence, the loading should have occurred on the Growth Factor but it did not. This indicator exhibited a sharp increase in 1972 followed by a decline in 1973 and 1974; this sharp fluctuation apparently caused complex loading. Although the decline in 1973 and 1974 could be expected in a base closure situation, there was no conclusive support to link the trends exhibited by this indicator to base closure.

The second complex indicator was S16, Part Time Municipal Employees. Peak periods in 1968 and 1971 followed by declines in 1969 and 1970, and 1972 and 1973, apparently caused complex loading of this indicator. As occurs in many municipalities, high expenditures in one year in a specific area can result in decreased spending and a tighter budget in that same area the following year. This appeared to have been the case as regards this indicator. Subjectively smoothing the peaks and valleys, the overall trend of this indicator implied that no impact was observed as a result of base closure.

The third complex indicator was S40, Water Quality,

Coliform Increase. Coliforms are a type of bacteria that are found in sewage. Measurement of one type, Escherichia coli, provides a means of indirectly measuring the amount of pathogenic organisms which may be present in water. Among the six complex indicators, Water Quality, Coliform Increase demonstrated the lowest correlation with any factor. In other words, it did not correlate with anything. This provided support to the finding that base closure had no effect upon this indicator.

The fourth complex indicator was S43, Department of Transportation Outlays. This indicator demonstrated an overall increasing trend with a wide range of fluctuations. The peaks in 1970, 1972 and 1975, and the valleys in 1969, 1971, and 1973 apparently caused complex loading. The overall increasing trend was a result of comprehensive transportation studies financed in part by the Department of Transportation; then implemented with Federal funds. For Laredo, this included funds for highway development, airport improvements, and urban mass transportation (40). However, no direct relationship could be drawn between this indicator and base closure.

The fifth complex indicator was S49, Total Federal Outlays, Laredo. Although the overall trend of this indicator demonstrated an increase over the eleven year study period, there was a sharp decline in 1970 in the Federal funds being provided directly to Laredo. The sharp

and unexpected decline apparently caused complex loading of this indicator. It should be noted, however, that there was no significant change in the total Federal funds being provided to Laredo at the time of base closure.

The sixth and last complex indicator was S63, Number of General Merchandise Retail Stores. Peaks in 1969 and 1972 apparently caused complex loading of this indicator. The overall trend of this indicator demonstrated a continual decline in the number of general merchandise retail stores over the study period and, thus, could not be attributed directly to base closure.

Having completed the discussion on complex indicators the remainder of this section will concentrate on the eight identified factors.

Growth Factor. The Growth Factor accounted for 62.2 percent of the variation among the 86 indicators. This factor, as did all of the others, demonstrated both positive and negative correlations among its respective set of indicators. A positive correlation meant an increasing trend was demonstrated over the study period, while a negative correlation meant a decreasing trend was demonstrated. Those indicators which exhibited a decreasing trend over the study period were:

S02	Tax Rate
S18	Percent Voting in Presidential Elections
S33	DOD Prime Construction Contracts
S70	Number of Urban Transport Employees

The remaining forty indicators which loaded on Factor 1 all demonstrated an increasing trend over the study period.

Examination of the time-series analysis supported, with 90 percent confidence, the finding that there was no statistically significant change in the Growth Factor for Laredo due to the closure of Laredo AFB. This statistical finding by itself is not conclusive; but, it does provide support to the subsequent subjective analysis.

Despite the base closure in 1973, Laredo continued to grow as demonstrated by the population indicator. Over the study period the population increased by 15 percent. Those indicators which were responsive to people's needs continued to rise also, unaffected by the base closure. Considering the tri-component model of the environment, there were comparable increases among the social, economic, and physical components. Similarly, the quality of life of the people in Laredo remained stable because of the constant rise in the Growth Factor indicators commensurately with the population.

The number of building permits issued, telephone connections, electrical connections, gas connections and water connections all increased, demonstrating that the community was responsive to the population's need for physical conveniences. During the early 1970's, Texas recorded an increase in population of 9.3 percent (47); hence, the growth trend in Laredo is consistent with the

growth trend in the state.

Diversified growth in Laredo could not have been sustained without a strong financial system. Indicators such as total bank deposits, total bank assets, and savings and loan total assets characterized growth and balance in the Laredo economy. From 1970 to 1974 the rate of growth in bank deposits for Laredo exceeded that of Texas by over 80 percent (47).

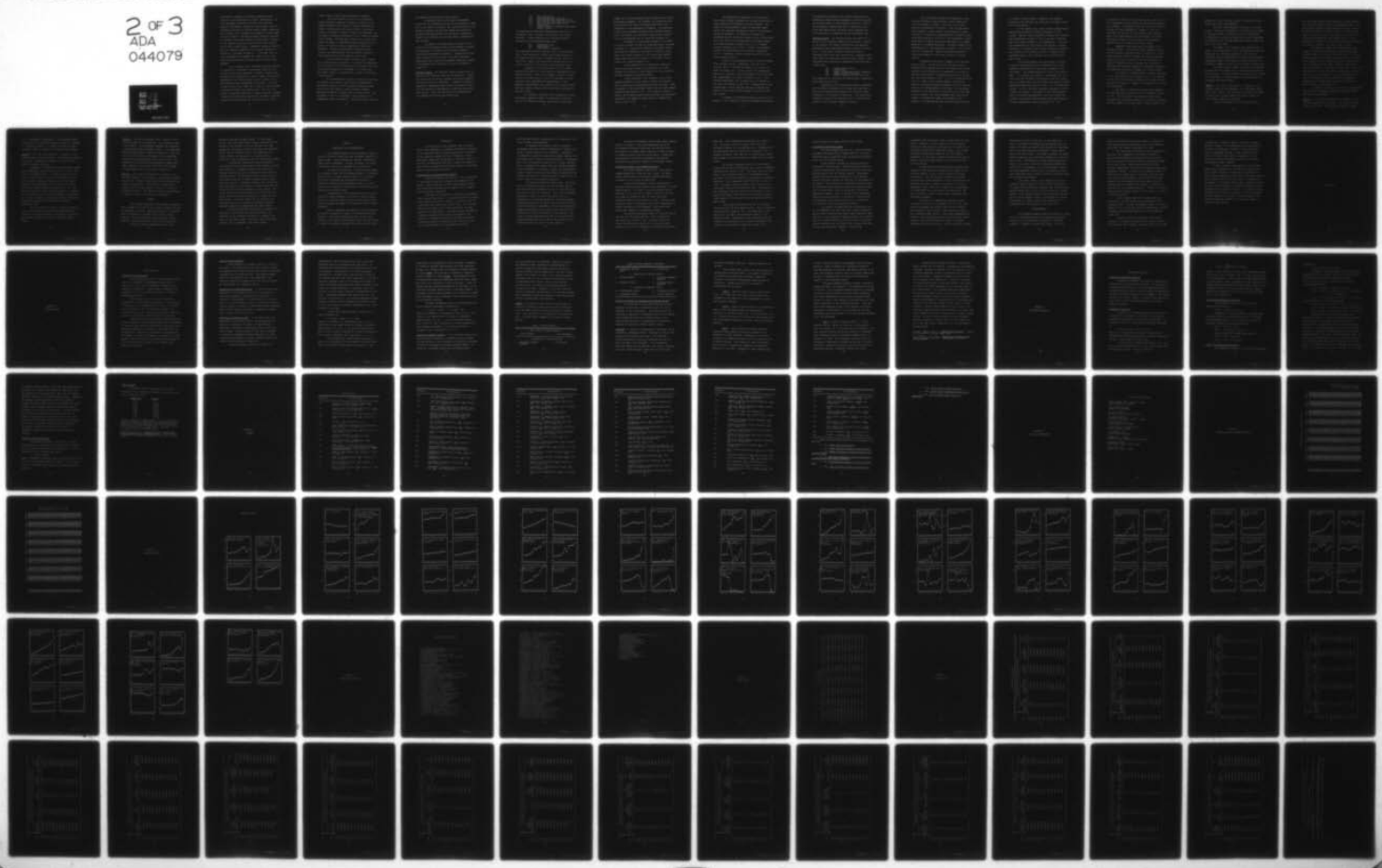
Commercial activities, the most important economic sector of Laredo, employed approximately one quarter of the labor force (42). Indicators such as dollars of retail sales and number of general merchandise employees reflected Laredo's role as a retail center for surrounding areas. Approximately $13 to $15 million was spent per year on the local economy by Laredo AFB before its closure (1). This amount, however, represented only 6 percent of the total present retail sales in Laredo. Approximately 70 percent of retail sales was dependent upon Mexican citizens from Nuevo Laredo and surrounding territory (1). Hence, economic growth and balance in the commercial area was primarily dependent upon Mexican trade vice Laredo AFB; base closure demonstrated no impact.

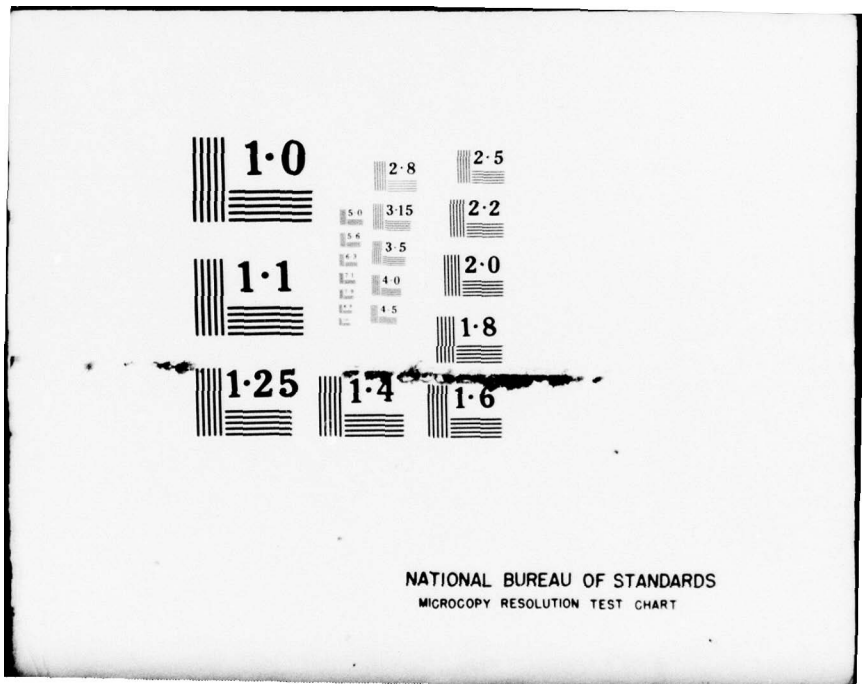
Government constituted an important segment of the Growth Factor. On the local level, expenditures for civic center and swimming pool, general government, health and hospital, public safety, sanitation, and public welfare all

AD-A044 079 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCHO--ETC F/G 1/5
THE ENVIRONMENTAL IMPACT OF BASE CLOSURE: A CASE STUDY OF LARED--ETC(U)
JUN 77 R O CARDINALE, R E KOHN

UNCLASSIFIED AFIT-LSSR-8-77A NL

2 OF 3
ADA
044079




1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5
2·8
3·15
3·5
4·0
4·5
5·0
5·6
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

demonstrated a balance in providing necessary social services to the population as it grew. Additionally, the local government was able to continue with necessary physical improvements, unabated by base closure, such as increasing the miles of sanitary sewers, graded streets and paved streets and by increasing the number of street lights and fire hydrants. The taxes assessed valuation continued to increase, indicating a greater taxable amount of assets in the community while the tax rate itself held constant at the time of base closure. Therefore, Laredo was able to meet its financial responsibilities without passing the burden on to the local population. At the same time, the local government had increased its number of full time municipal employees and the total number of police hours expended.

On the Federal level, Government funding continued to increase for DOD Reserve and National Guard pay; DOD military retired pay; Department of Health, Education and Welfare outlays; Department of Labor outlays; Civil Service expenditures; and total Federal outlays for Webb County. Two indicators were interesting to note here. One, even though the base closed there was no effect on the pay drawn by retired military in the Laredo area. And, two, even though a substantial reduction in Federal funds was observed through loss of DOD prime construction contracts, other DOD contracts and military and DOD civilian pay, the total

Federal funds in Webb County continued to increase.

The social quality of life of the increasing Laredo population remained in balance as evinced by the similar increase in the number of students registered in Laredo's school system, the total volumes in the Public Library, the number of doctors' offices and employees, and the number of graduate education division students at Laredo Junior College. Interestingly, however, as a social indicator, the number of registered voters increased while the percent of those who voted in presidential elections decreased. Though not significantly affected by base closure, the disenchantment with the Federal decision to close Laredo AFB may be reflected in this factor.

As an additional social indicator, total arrests for criminal activity increased. To apparently compensate for this natural trend--when population increases--the total police hours expended also increased at a similar rate. Once again, though, not significantly enough to be related to base closure.

As a consideration of growth affecting the physical environment, the number of motor vehicle registrations increased in Laredo by over 100 percent during the study period while the number of urban passenger transport employees decreased 17 percent from its peak in 1967. This indicates a shift in the desires of the population for independent travel and mobility. Neither indicator, however,

was significantly effected by base closure.

A favorable factor in the Laredo development outlook was its strategic location for the transfer of goods out of the interior of Mexico. The continual growth of the dollars of imports arriving into Laredo from across the Mexican border demonstrated that the import business continued to be a mainstay of the area economy, uneffected by base closure.

In summary, the Growth Factor accounted for the majority of the variation within the environment of Laredo by explaining 62.2 percent of the variation among 86 individual environmental indicators. Supporting the time-series analysis of this factor, a subjective analysis demonstrated that there was no apparent significant change in the Laredo Growth Factor due to the 1973 closure of Laredo AFB.

Extrinsic Factor. The Extrinsic Factor accounted for 15.2 percent of the variation among the 86 indicators. Within this factor the distinction between positive and negative correlations was very pronounced. A negative correlation represents a decreasing trend after base closure, while a positive correlation represents an increasing trend after base closure. Those six indicators which demonstrated a decreasing trend after base closure were:

S27	DOD Civilian Pay
S28	DOD Military Active Duty Pay
S32	DOD Prime Service Contracts, Value
S34	DOD Contracts Less Than $10,000, Value
S46	Office of Economic Opportunity Expenditures
S53	Five or More-Unit Housing Construction Permits Issued

ne remaining ten indicators demonstrated a positive, or increasing, trend. However, an increase is not always favorable. Those indicators which increased where an increase was considered unfavorable were:

S24	Unemployment Rate
S54	Drug Arrests
S82	Total Traffic Accidents

The time-series analysis supported, with 90 percent confidence, the finding that a significant change occurred in the Laredo Extrinsic Factor subsequent to the closure of Laredo AFB. Again, this statistical finding was not, by itself, conclusive, but a strong implication was there.

Subsequent to the base closure in 1973, Laredo experienced change in its environment as represented by the Extrinsic Factor. Some of this change is directly attributable to the base closure, such as the decrease in those indicators that represented DOD expenditures. Other elements contributing to the change in the Extrinsic Factor were also present; however, most were totally unrelated to the base closure.

For instance, indicators which represented non-DOD governmental agencies (namely the Department of Agriculture and the Office of Economic Opportunity) encountered

change due to shifting emphasis and responsibilities within governmental programs. For instance, the responsibilities and funding of the Office of Economic Opportunity were transferred to the Department of Commerce. The Department of Agriculture expanded operations and increased expenditures, particularly in the areas of agricultural conservation and supplemental food for women and children (29).

In addition, a substantial increase in the number of tourists, either visiting or transiting Laredo, resulted in change (1). The positive effects of increased tourism were noted by increases in the number of taverns, restaurants, and service stations (42:35), while some negative effects were evinced by increases in the number of drug arrests and traffic accidents (1).

A much needed effort to upgrade the inadequate Laredo storm sewer system (42:58) resulted in a sharp increase in the miles of storm sewers, but this occurrence was also unrelated to the base closure.

A final indicator in the Extrinsic Factor which surged subsequent to base closure, but was not attributable to base closure represented the export business. About 60 percent of the trade between Mexico and the United States passes through Laredo (41:15). Also, Laredo's principal exports are mining and agricultural machinery and electrical appliances; the demand for these items in a modernizing Mexico, rose (42:11).

The remaining two indicators in the Extrinsic Factor which changed subsequent to the base closure are at least partially attributable to the base closure. The number of building permits issued for apartment/condominium type complexes decreased in spite of the continued population increase. The potential for impact was heightened because construction began on over 100 new apartments just prior to the announcement of the base closure and present apartments already had a 50 to 75 percent military occupancy rate (42:60). Further, the permanent residents of Laredo prefer not to dwell in apartments (42:61). Therefore, the base closure resulted in a saturated apartment market.

Finally, the unemployment rate in Laredo increased after the base closure. Apparently, the loss of 523 civilian jobs (1.75 percent of Laredo's work force) did impact on Laredo (29). In July of 1973, the unemployment rate was 11.4 percent, and it was predicted by an OEA study that unemployment could reach 20 percent (42:49). The average unemployment rate in Laredo was 14.78 percent in 1974 and 19.08 percent in 1975 (29). Although some of the increase may be due to periodic influxes of migrant farm workers (42:48), some of the increase is also due to the base closure.

In summary, the Extrinsic Factor accounted for 15.2 percent of the variation in the 86 environmental indicators.

The time-series analysis of this factor indicated that a substantial change occurred subsequent to the base closure, and provided support to the subjective analysis. The subjective analysis demonstrated that, in addition to the direct DOD expenditures, the base closure impacted upon the construction of apartments and the unemployment rate.

Intrinsic Factor. The Intrinsic Factor accounted for 7.1 percent of the variation among the 86 indicators. Similar to the previous two factors, both positive and negative correlations were demonstrated among the subset of indicators. In this case, a positive correlation meant a decreasing trend after base closure while a negative correlation meant an increasing trend after base closure. Those indicators which exhibited an increasing trend after base closure were:

S39	Student Teacher Ratio
S64	Labor Force
S66	Number of Wholesale Grocery Companies
S80	Number of Police Assigned
S81	Percent Manned, Laredo Police Force

The remaining five indicators all demonstrated a decreasing trend after base closure.

Examination of the time-series analysis supported, with 90 percent confidence, the finding that there was a statistically significant change in the Intrinsic Factor subsequent to the closure of Laredo AFB. This statistical finding by itself is not conclusive; but, it does provide support to the following subjective analysis.

The local media indicator was a measure of local television stations, radio stations, movie theaters and drive-in theaters in Laredo. From 1965 to 1973 local media had increased by 100 percent. Over the same period and subsequent to base closure, the population of Laredo continued to increase, as demonstrated in the Growth Factor. Local media existed as a portion of the population's social environment and should have varied according to the demand generated by increased population. The major change in the characteristics of the population in Laredo in 1973 was the closure of Laredo AFB. Hence, the measured decrease in local media appeared to have been a result of the base closure.

Government constituted a segment of the Intrinsic Factor as well. On the local level, the total police assigned and the percent manned of the Laredo Police Force served as social indicators for preserving the quality of life for the populace. A decreasing trend in both indicators was noted starting in 1970. By 1973 the manning was at a low of 72 men, or 85.1 percent manned. After 1973, however, the manning steadily increased until 1975 when the force was 100 percent manned with 85 men. The individual findings on this indicator are inconclusive, but with base closure a reality, the local government may have found it prudent to increase the number of policemen to full strength to accommodate the newly acquired assets realized

as a result of base closure. Therefore, the measured increase in this indicator may have been a favorable impact due to base closure.

On the Federal level, Small Business Administration Expenditures decreased 40 percent subsequent to base closure. However, further analysis disclosed that unusually high expenditures occurred in 1973 in the way of disaster loans (for reasons unknown to the researchers). Thus, the high expenditures in 1973 coupled with recovery to normal operations in subsequent years caused unexpected loading of this indicator on the Intrinsic Factor. Therefore, the decreasing trend in this indicator was not attributed to base closure.

The student-teacher ratio and number of students at Laredo Junior College are two indicators which would normally be associated with the social component of the environment. The student-teacher ratio was at its worst in 1969: 27.42 students per teacher. Considering that, the lower the ratio the better the potential quality of education, the lowest ratio over the entire study period occurred immediately after base closure in 1974: 22.70 students per teacher. By 1975, the ratio recovered (declined) to 23.19 students per teacher. The change in the student-teacher ratio was directly attributable to the loss of about 800 students when military families moved away, ameliorated by 250 new students who entered the system (42). The

enrollment at Laredo Junior College reached a high of 1562 in 1973; subsequent to base closure the enrollment decreased by 25 percent. The apparent cause was the loss of enrolled military and their dependents. However, by 1975 the enrollment did recover and 1530 students were enrolled. Hence, the student-teacher ratio and number of students registered at Laredo Junior College both experienced apparent short run impacts due to base closure.

Commercial activities were also present in the Intrinsic Factor. As previously noted, commercial activities are the most important sector of Laredo (42). While retail sales and number of general merchandise employees remained in balance as a part of the Growth Factor, the number of wholesale grocery companies and the number of trucking and warehousing companies and employees appeared to have been more sensitive to changes due to base closure.

The number of wholesale grocery companies decreased in 1973 and recovered only slightly by 1975. The implication was that those companies dealing with Laredo AFB were forced out of business. However, this implication could not be substantiated.

The number of trucking and warehousing companies and employees both declined in 1973 and recovered slightly by 1975. The implication, once again, was that those companies that conducted business with Laredo AFB (primarily with the movement of military family household goods) lost

business as a result of base closure. However, this implication could not be substantiated.

The labor force decreased subsequent to the base closure. Although the decrease is not directly attributable to the base closure, the base closure was a contributor. The departure of civilian employees and military dependents, in conjunction with the high unemployment rate, reduced the size of the labor force.

In summary, the Intrinsic Factor accounted for 7.1 percent of the variation in the 86 environmental indicators. Supporting the time-series analysis of this factor, a subjective analysis demonstrated that there was an apparent significant change in the Intrinsic Factor and nine of its individual indicators due to the 1973 closure of Laredo AFB.

The major factors--Growth, Extrinsic and Intrinsic--accounted for 84.5 percent of the variation in the environment of Laredo. The minor factors accounted for 14.6 percent of the variation in the environment and were generally not associated with base closure.

Factor 4. This factor accounted for 4.6 percent of the variation among the 86 indicators. Two indicators loaded high on this factor: DOD prime supply contracts and number of single unit housing construction permits issued; the later showed a negative correlation.

Subjective analysis of the exhibited trends in

both indicators supported the time-series analysis results, that the factor had, in effect, no discernible trend. DOD prime supply contracts varied eccentrically from a high of $2,053,000 in 1968, to $22,000 in 1970, to another local high of $1,445,000 in 1974, and finally to $14,000 in 1975. Although this expenditure was related directly to the existance of the base, its prior random fluctuation obscured its impact to Laredo at the time of base closure.

The number of single-unit housing permits also varied considerably over the study period but with more apparent reason. The overall trend from 1965 to 1972 was a steady increase in the number of permits issued. However, in anticipation of the impending closure of Laredo AFB in 1973, the demand for new single dwellings dropped drastically through 1973. The market bottomed out in 1974 with the release of 475 military family housing units for occupancy by the local population. In 1974 there was a substantial natural gas find in Laredo which immediately stimulated the housing market and caused the number of permits issued to rise sharply (29).

In summary, this analysis of Factor 4 demonstrated that there was no apparent change in this factor due to the closure of Laredo AFB.

Factor 5. This factor accounted for 3.9 percent of the variation among the 86 indicators. One indicator loaded high on this factor: water quality, bacteria increase

(very high negative correlation). This indicator varied eccentrically over the entire period of study and followed no discernible pattern. The random fluctuations demonstrated no impact to Laredo at the time of base closure.

Factor 6. This factor accounted for 3.1 percent of the variation among the 86 indicators. Two indicators loaded on this factor: Department of Commerce outlays and total guilty of traffic violations.

Department of Commerce outlays demonstrated random and insignificant variation prior to 1974. In 1975, however, it increased sharply. It should be noted that the trend in total Federal outlays for both Laredo and Webb County remained relatively stable over the same period. Conversly, the expenditures for the Office of Economic Opportunity dropped drastically from 1973 to 1975. The drastic increase in outlays by the Department of Commerce had no direct link to base closure; rather, it was caused by a change in Federal funding responsibility between The Department of Commerce and the Office of Economic Opportunity (29).

The total guilty of traffic violations indicator varied eccentrically over the entire study period and followed no discernible pattern. The random fluctuations demonstrated no impact to Laredo at the time of base closure.

Factor 7. This factor accounted for 1.7 percent of the variation among the 86 indicators. Two indicators loaded on this factor: fire department employees and Department of Housing and Urban Development outlays. Fire department employees demonstrated a negative correlation. There was little or no variation in the number of fire department employees and no discernible link to base closure. The Department of Housing and Urban Development experienced a sharp increase in 1972 due to the Model Cities program, but again there was no link to base closure (29).

Factor 8. This factor accounted for 1.3 percent of the variation among the 86 indicators. One indicator loaded on this factor: General Services Administration expenditures (negative correlation). This indicator varied eccentrically over the entire period of study and followed no discernible pattern. The random fluctuations demonstrated no impact to Laredo at the time of base closure.

SUMMARY

This chapter described the methodology and analysis used to assess the impact of the closure of Laredo AFB upon the community of Laredo. Data was collected on 86 environmental indicators via personal interviews and library research. The indicators were then evaluated by factor analysis, time-series analysis, and subjective analysis.

The factor analysis procedure reduced the 86

indicator data base to eight factors. Of these eight factors, the first three (major) factors accounted for 84.5 percent of the variation in the 86 indicators and were subsequently identified as the Growth Factor, the Extrinsic Factor, and the Intrinsic Factor. The remaining five (minor) factors, accounting for 14.6 percent of the variation in the 86 indicators, were not specifically named.

A preliminary time-series analysis evaluation indicated that only the major factors were amenable to time-series analysis. Time-series analysis was then used to evaluate the Growth Factor, the Extrinsic Factor, and the Intrinsic Factor. The respective factor scores prior to base closure were used to predict expected factor scores after base closure. Confidence intervals were constructed about the predicted factor scores to enable comparison with the actual factor scores subsequent to base closure. The actual scores for the Growth Factor fell within the predicted confidence interval indicating no change after the base closure. The actual scores for the Extrinsic and Intrinsic Factors fell outside the predicted confidence intervals indicating a change after the base closure.

Subjective analysis was employed to evaluate the variation in the factors and, where appropriate, the variation in the individual indicators to determine the impact of the base closure. Conclusions drawn from these analyses will be presented in the final chapter.

Chapter 4

CONCLUSIONS AND RECOMMENDATIONS

This research assessed the environmental impact of the 1973 closure of Laredo AFB upon the nearby community of Laredo, Texas. The environment, as defined, consisted of three primary components: economic, physical, and social. The topical scope of this research was a case study.

The specific problem was: the DOD has been unable to accurately assess the environmental impact of a military base closure on a nearby community prior to the closing. The Federal Government had recognized the problem of accurately assessing the environmental impact of a base closure with a plethora of legislation, DOD directives, and Presidential Executive Orders.

Investigation of the environmental impact of base closure was begun primarily as a result of public concern. The need to evaluate exactly how and to what extent communities experience the impact of closings was and is clearly important.

However, measuring the impact of a base closure is a difficult problem and a variety of techniques have been employed. Sufficient investigation has not been accomplished in the field of environmental impact of base closure to render one standard technique more valid than any other.

CONCLUSIONS

The objectives of this research were to identify factors which represent the community environment, ascertain if the identified factors changed significantly subsequent to the closure of Laredo AFB, and to determine if that significant change was attributable to the base closure. To this end, the methodology employed to assess the impact of base closure on Laredo involved factor analysis, time-series analysis, and subjective analysis.

Identification of Environmental Factors

The first research question was: what factors can be identified by analyzing community environmental indicators? Three major and five minor environmental factors were identified, representing an original list of eighty-six environmental indicators.

The data on the eighty-six indicators was gathered over an eleven year period. A continuous stream of discrete fiscal year end values was difficult to obtain; hence, the study period was defined from 1965 to 1975. This included data for nine years prior to base closure and two years subsequent to base closure. The data was then submitted to principal component factor analysis to determine the patterns of covariation among the individual indicators. Three major factors, accounting for 84.5 percent of the total variance among the 86 indicators were found,

and five minor factors, accounting for 14.6 percent of the total variance, were extracted.

It appeared that certain aspects of Laredo's environment carry the burden of responding to trends influenced by various aspects of the community. Therefore, environmental indicators should be considered together as a set rather than in terms of individual trends. The measurement of the environmental impact due to a single indicator fails to highlight the dynamic and inter related qualities of each indicator to the others. Hence, the environmental impact of base closure should be evaluated according to its systemic qualities, at the factor level, instead of just in terms of effects on individual indicators.

The major environmental factors were: the Growth Factor, the Extrinsic Factor, and the Intrinsic Factor. The Growth Factor represented the set of indicators which were closely linked to population. This factor continually increased, or grew, over the study period due to a combination of increasing population, increasing capital, increased expenditures for public services, and inflation. The Extrinsic Factor represented a set of indicators which changed significantly at the time of base closure due to influences not within the control of the community. The Intrinsic Factor represented the set of indicators which changed significantly at the time of base closure due to influences within the control of the community.

The minor environmental factors were simply labeled Factors 4 through 8. They each represented one or two environmental indicators which were not included within the subsets of the major factors because of their eccentric or random fluctuation over the study period. Though each had an effect on the total environment, they were not considered as significant community environmental factors.

Significant Change in Environmental Factors

The second research question was: what factors changed significantly after the base closed? Two major factors demonstrated a statistically significant change subsequent to the closure of Laredo AFB.

The major environmental factors constructed by principal component factor analysis were submitted to a time-series analysis. The trend of the environmental factors from 1965 to 1973 was used to predict values for 1974 and 1975 under the assumption that the trend would have continued unabated had the base not closed. Intervals were constructed about the predicted values which represented 90 percent confidence in the forecasts. Then, the actual values were compared to the predicted values.

The optimum time-series model for the Growth Factor used for the 1974 prediction was: type 2 exponential smoothing with α equal to .305. The actual value fell within the confidence interval of the predicted value. Similarly, for the 1975 prediction, the optimum time-series

model was: type 3 exponential smoothing with α equal to .200. The actual value, once again, fell within the confidence interval of the predicted value. Examination of the time-series analysis supports the conclusion, with 90 percent confidence, that there was no statistically significant change in the Growth Factor for Laredo after the base closed.

The optimum time-series model for the Extrinsic Factor used for the 1974 prediction was: type 2 exponential smoothing with α equal to .500. The actual value fell outside of the confidence interval of the predicted value. Similarly, for the 1975 prediction, the optimum time-series model was: type 2 exponential smoothing with α equal to .510. The actual value, once again, fell outside of the confidence interval of the predicted value. Examination of the time-series analysis supports the conclusion, with 90 percent confidence, that there was a statistically significant change in the Extrinsic Factor for Laredo after the base closed.

The optimum time-series model for the Intrinsic Factor used for the 1974 prediction was: type 2 exponential smoothing with α equal to .449. The actual value, once again, fell outside of the confidence interval of the predicted value. Examination of the time-series analysis supports the conclusion, with 90 percent confidence, that there was a statistically significant change in the

Intrinsic Factor for Laredo after the base closed.

Occurrences Influencing Change

The third research question was: what occurrences influenced the significantly changed factors? This study identified those occurrences which influenced the Extrinsic Factor and the Intrinsic Factor.

Factor analysis reduced the original eighty-six indicators to eight factors. Through subsequent analysis, the major factors were identified as the Growth Factor, the Extrinsic Factor and the Intrinsic Factor. Time-series analysis was used to make predictions for the expected values of the major factors for 1974 and 1975 had Laredo AFB not closed. The construction of confidence intervals about the predicted values permitted statistical evaluation which led to the conclusion that two of the major factors had significant changes. Hence, the power of the methodology employed allowed assessment of the impact of base closure by subjectively analyzing the causes for 22.3 percent of the variation in the environmental indicators.

The authors concluded that the occurrences in the set of indicators over which the local community generally had no control--the Extrinsic Factor--were effected by base closure. In the category of Federal spending, DOD civilian pay, DOD military active duty pay, the value of DOD prime service contracts, and the value of DOD contracts less than $10,000 were unfavorably impacted: these dollars

disappeared from the economic base of Laredo when the base closed. Important to note, however, the total Federal outlays for Webb County was contained in the Growth Factor: the Federal dollars kept coming into Laredo. Even though there was an unfavorable impact in four DOD spending categories, in the long run Laredo was receiving as much in Federal funds after base closure as it was when the base was still active.

The apartment construction market was unfavorably impacted by base closure as evinced by the number of construction permits issued for five or more-unit housing (apartments). When the military population left Laredo they left many vacant apartments. As the OEA reported, the permanent residents of Laredo do not desire to live in apartments, hence, there was no demand for the apartments. The unemployment rate rose sharply, as predicted by the OEA, as a result of base closure; hence unemployment was unfavorably impacted.

Similarly, the researchers concluded that the occurrences in the set of indicators over which the local community generally had control--the Intrinsic Factor--were effected by base closure. Local media were unfavorably effected by base closure. Local media represented the number of local television stations, radio stations, movie theaters, and drive-in theaters in Laredo; the number decreased when the base closed. Further unfavorable impacts

attributable to base closure were, in the commercial sector, the number of wholesale grocery companies and the number of trucking and warehousing companies and employees; each of the three indicators decreased in number immediately after base closure. The number of students at Laredo Junior College was also unfavorably impacted as a result of base closure. Confounding an already existing problem in Laredo, the closure of the base unfavorably effected the labor force; the departure of civilian employees, military and their dependents from the base, in conjunction with a high unemployment rate, reduced the size of the labor force and increased unemployment.

There were, however, three apparent positive or favorable impacts noted as a result of the base closure. The Laredo Police Department increased their force size and percent manned from a low in 1973--72 men and 85.1 percent manned--to the highest figures in the study period--85 men and 100 percent manned. Equally as important in a social environment, the Laredo public schools improved the student-teacher ratio slightly in 1974 and 1975.

RECOMMENDATIONS

This research operated under the premise that there are inter relationships which occur among environmental indicators of the three basic components of the total community: economic, physical, and social. It is the

belief of the authors that future research on impacts of base closure continue along these lines vice dividing the environment into separate components for study.

The three major environmental factors obtained in this study are comparable to the results obtained on individual environmental indicators from prior studies. Most environmental indicators showed no significant impact due to base closure; while those associated with DOD funding, unemployment, labor force, and housing market were apparently impacted. In spite of the tremendous amount of effort and the large number of indicators that were used, the rather restricted range of factors which were found suggests that considerable additional research must be completed before a community environment, as effected by base closure, is completely described. However, the authors believe the methodology employed in this study is a step in the proper direction.

In this regard, additional studies should be conducted to further validate the environmental factors developed herein. The most advantageous means of validation appears to be by using data which has already been collected to support previous investigations in the environmental impact area.

A wealth of data for individual environmental indicators is normally available within a given community for some given year; however, continuous data for that same

indicator over a number of years is difficult to obtain. Under the concept of the Comprehensive Plan maintained by the Base Civil Engineer, continuity of data collection should be reasonably assured. Future research efforts should investigate these data to determine if it can provide the relevant information required for accurate environmental impact forecasts.

Finally, previous investigations in the environmental area concentrated on the impact of a base closure upon a nearby community by examining the indicators or factors which change when a base closes. The authors believe that formidable results may be achieved by comparing the environment of a community located near a military installation with the environment of a community completely disassociated from the military influence. The questions being: what factors are similar or different in both environments and what changes could be made in the environment of the military associated community to mitigate the negative aspects of base closure.

APPENDICES

APPENDIX A

FACTOR ANALYSIS

Factor Analysis

Purpose of Factor Analysis

Factor analysis is based on the proposition that if there is a systematic interdependence among a set of variables it must be due to something fundamental which creates the commonality. Factor analysis summarizes the commonality of all the variables and hence is used as a data-reduction method.

Factor analysis has as its most distinctive characteristic a data-reduction capability. The technique of data-reduction or summarization is primarily concerned with the strength of all the variables selected to be studied with each other. Hence, factor analysis attempts to account for the maximum variation among the variables.

Observing an array of correlation coefficients for a set of variables, factor analysis permits one to determine if there are some underlying relationships that exist which enable the variables to be reduced. The reduction of the variables into a smaller set of factors or components may be compared to moving up a hierarchy, from specific to more general. Hence, the factors or components may be taken as source variables which account for the observed inter relations in the data.

Types of Factor Analysis

Factor analysis is a general term for a variety of procedures. The classification of factor analysis subsets are organized around major alternatives at each of the three customary steps of factor analysis. The three customary steps of factor analysis are: the preparation of the correlation matrix, the extraction of the initial factors, and the rotation to a terminal solution.

Preparation of correlation matrix. In the first step, the preparation of a correlation matrix, the calculation of appropriate measures of association for the set of variables is accomplished. The major option in the first step is the choice between R-type or Q-type factor analysis. R-factor analysis is based on correlations between variables, while Q-factor analysis is based on correlations between units (objects, individuals, etc.).

Extraction of initial factors. In the second step, the extraction of the initial factors, the construction of a new set of variables on the basis of inter relations exhibited in the data is accomplished; hence, data reduction is begun. The new variables, then, may be obtained by using exact mathematical transformations or by using inferrential assumptions; principal component analysis and classical-factor analysis, respectively.

Principal-component analysis is a method of

transforming a set of variables into a set of principal components that are uncorrelated with each other. No assumptions are required about the underlying structure of the variables. The objective is to find the weighted combination of variables which would account for more of the variance than any other linear combination. The first principal component, then, is the single best summary of linear relationships displayed, the second component is the second best linear combination of variables, under the condition that the second component is uncorrelated to the first. Subsequent components are defined until all the variance is accounted for. The principal-component solution initially requires as many components as variables unless at least one variable is perfectly determined by the other variables in the data.

The principal component model is expressed in a linear expression as:

$$Z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jn}F_n$$

where Z_j is variable j in standardized form; a_{j1} is a coefficient of the common factor of variable j attached to common factor 1; F_1, F_2, ..., F_n are the common factors, each of which in turn is defined as a linear combination of the n original variables; and j may equal 1, 2, ..., n.

On the other hand, classical-factor analysis is based on the assumption that the observed correlations are mainly the results of some underlying regularity. More

specifically, the assumption is that a variable is composed of shared and unshared relationships with other variables. The part of a variable that is influenced by shared elements is called common, while the part influenced by singularly distinct elements is called unique. The assumption is that the relationship among the variables comes from their common part and is not influenced by their unique part. Hence, it follows that any observed correlations are the result of the correlated variables sharing some of the common elements. It is assumed that the common elements will be smaller in number than the original list of variables while accounting for all of the observed relations.

The basic mathematical model of the factor analysis can be compactly expressed as noted below:

$$Z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jm}F_m + a_jU_j$$

where Z_j is variable j in standardized form; a_{j1} is a coefficient of the common factor of variable j attached to common factor 1; F_1, F_2, ..., F_m are the common factors, each of which in turn is defined as a linear combination of the m original variables; U_j is the unique factor of variable j; and j may equal 1, 2, ..., m.

Rotation to terminal factors. In the third and final step in factor analysis, rotation to a terminal solution, simpler and more meaningful factor patterns are achieved by selection of either an orthogonal or oblique rotational method. By definition, orthogonal factors are uncorrelated while

oblique factors may be correlated. Whether the factors are defined as exact mathematical transformations or inferred assumptions (principal-component analysis or classical-factor analysis respectively) the exact configuration of the factor structure is not unique; the basic assumptions will not be violated when one factor solution is transformed into another. Hence, there are many equivalent ways to identify the underlying elements of the same set of data. Normally, at this point one has a choice of rotational methods-there is no one best solution. While orthogonal factors are simpler to handle the oblique factors are empirically more realistic.

Summary. The steps and major options discussed are not invariably followed in every factor analysis, neither do the three steps completely exhaust the possible alternatives. Any combination of the three pairs of options may occur. The table below summarizes the types of factor analysis.

Types of Factor Analysis

Major steps in factor analysis	
Major options	Key references
1. Preparation of factor analysis	
a. Correlation between variables	a. R-factoring

Types of Factor Analysis (continued)

b. Correlation between units	b. Q-factoring
2. Extraction of initial factors	
a. Defined factors	a. Principle-component analysis
b. Inferred factors	b. Classical-factor analysis
3. Rotation to terminal factor	
a. Uncorrelated factors	a. Orthogonal rotation
b. Correlated factors	b. Oblique rotation

Technique Utilized to Determine Environmental Factors

The technique of using factor analysis involves extremely tedious hand calculations; hence, the use of computers is very advantageous. This technique will be explained as applicable to subprogram FACTOR of the Statistical Package for the Social Sciences (SPSS) on the Computational Resources for Engineering and Simulation Training and Education (CREATE) computer system.

Procedure. A variety of factor-analytic techniques can be performed by subprogram FACTOR. Input may be from an SPSS system file or from raw data input. Five different factoring methods are available (although only two have been discussed in this appendix). Four alternative rotational methods can be applied to the various factoring solutions, three orthogonal types and one oblique type.

The three orthogonal types are: varimax, quartimax, and equimax.

SPSS permits total control over the criteria for extracting and rotating factors. The number of factors to be extracted and rotated may be directly specified. Similarly, the number of permissible iterations may be controlled. Options also exist for the precise configuration of the output.

Step 1. Input raw data to form an SPSS system file. The system file will form a matrix; where a row represents a data year and a column represents a specific environmental indicator.

Step 2. Select R-factor analysis to determine the effect of the correlation among the environmental indicators in the SPSS system file. This will result in an i x j correlation matrix which quantifies the correlation of each environmental indicator with every other environmental indicator.

Step 3. Select principle component analysis. Classical factor analysis requires an estimate of the communality of each variable. Communality is the total variance of a variable accounted for by the combination of all common factors. This communality must be estimated, based on faith or assumptions regarding the underlying regularity of the data. Estimates of these communalities

is one of the most difficult and ambiguous tasks in factor analysis. Dozens of methods for estimating communality have been proposed but none have been proven superior to any other, and factorial solutions are only slightly affected by the use of 'commonalities' or unities in the principal diagonal of the correlation matrix.

Principal-component analysis, however, requires no assumptions about, or estimates of, the underlying structure of the data. Also, principal-component analysis is designed to obtain a solution wherein the first factor represents that linear combination of the variable indicators which accounts for more of the variance in the data than any other linear combination of the variable indicators. Since the first factor explains as much of the variance as possible, observation of the behavior of this factor will provide information about the behavior of the inter related variation in all the indicators.

Step 4. Select orthogonal rotation. Oblique rotation does not impose the condition of orthogonality upon the factors; i.e., the factors may be correlated. However, oblique rotation can be very difficult to interpret. With orthogonal rotation, correlation between factors is defined to be zero. But, orthogonal rotation offers the advantage of being able to compare the results of optional variations. Because of simplicity and the availability of interesting options, orthogonal rotation was chosen.

Having chosen orthogonal rotation, varimax orthogonal rotation will be selected. Although all three methods, quartimax, varimax, and equimax, have the same goal, that of obtaining meaningful factors, the approach used to achieve that goal varies. Quartimax orthogonal rotation has the aim of reducing the complexity of a variable to a minimum by rotating the factors so that each variable loads high on one factor (has high correlation with), but nearly zero on all other factors. This procedure emphasizes simplifying the rows of the factor matrix; the variable indicators. Varimax orthogonal rotation, on the other hand, attempts to simplify the columns of the factor matrix by maximizing the variance of the squared loadings in each column. Varimax rotation is the only method where the factors tend to be invariant, meaning varimax factors obtained in a sample will have a greater likelihood of portraying the universe varimax factors. The final optional method, equimax orthogonal rotation, attempts to simplify both rows and columns, but not to the same extent, respectively, as the quartimax or varimax methods.

Sources: Harman, Harry H. Modern Factor Analysis. Chicago: The University of Chicago Press, 1960.

Nie, Norman H., and others. Statistical Package for the Social Sciences. New York: McGraw-Hill Inc., 1975.

APPENDIX B

TIME-SERIES ANALYSIS

Time-Series Analysis

Purpose of Time-Series Analysis

Time-series analysis with regard to forecasting is classified as a curve-fitting technique. The objectives of time-series analysis are to: evaluate significant trends in historical data, damp out noise or random fluctuations in the data, dynamically respond to true changes in the process as they occur, project trends to required future periods as they occur, and perform these objectives with optimum forecast parameters.

Exponential Smoothing

The method of time-series analysis to be employed is exponential smoothing. At the heart of exponential smoothing are equations for all orders of smoothing. The fundamental equation of first-order exponential smoothing is:

$$\hat{y}(t),1 = \alpha y(t) + (1-\alpha)\ \hat{y}\ (t-1),1$$

where $\hat{y}(t),1$ denotes the t th value of the first-order exponentially smoothed statistic and α denotes the smoothing constant, a real number such that $0 \leq \alpha \leq 1$.

The value $\hat{y}(t),1$ contains some portion of all data which has been smoothed from t = 0 even though no back data are specifically held. It can be shown that

$$\hat{y}(t),1 = \alpha \sum_{i=0}^{t-1} \beta^i y(t-i) + \beta^t \hat{y}(0),1$$

where $\beta = (1-\alpha)$ and $\hat{y}(0),1$ is the initial smoothing estimate from which it can be observed that: all past data are held in the average $\hat{y}(t),1$; since α and β are fractional weights, the data are most heavily weighted for recent values and the weights decrease monotonically as data become older, so the advantage is given to the most recent data; as t becomes larger the contribution of the initial smoothing estimate $\hat{y}(0),1$ will be damped out.

Second-Order Exponential Smoothing

The fundamental equation for second-order exponential smoothing is:

$$\hat{y}(t),2 = \alpha\hat{y}(t),1 + \beta\hat{y}(t-1),2$$

Estimates of the coefficients of the first-order polynomial model are obtained from the first and second-order smoothed statistics, $\hat{y}(t),1$ and $\hat{y}(t),2$, using the following intercept and slope relationships:

$$\hat{b}_o(t) = 2\hat{y}(t),1 - \hat{y}(t),2$$

$$\hat{b}_1(t) = (\alpha/\beta)\,[\hat{y}(t),1 - \hat{y}(t),2]$$

Initial conditions to start smoothing are:

$$\hat{y}(0),1 = y(0) - (\beta/\alpha)\hat{b}_1(0)$$

$$\hat{y}(0),2 = y(0) - 2(\beta/\alpha)\hat{b}_1(0)$$

Third-Order Exponential Smoothing

The fundamental equation for third-order exponential

smoothing is:

$$\hat{y}(t),3 = \alpha\hat{y}(t),2 + \beta\hat{y}(t-1),3$$

Estimates of the coefficients of the second-order polynomial model are computed based upon the first-order, second-order, and third-order smoothed statistics ($\hat{y}(t),1$; $\hat{y}(t),2$ and $\hat{y}(t),3$, respectively) using the following relationships:

$$\hat{b}_o(t) = 3[\hat{y}(t),1] - 3[\hat{y}(t),2] + \hat{y}(t),3$$

$$\hat{b}_1(t) = (\alpha/2\beta^2)[(1 + 5\beta)(\hat{y}(t),1) - (2 + 8\beta)(\hat{y}(t),2) + (1 + 3\beta)(\hat{y}(t),3)]$$

$$\hat{b}_2(t) = (\alpha^2/2\beta^2)[(\hat{y}(t),1) - 2(\hat{y}(t),2) + (\hat{y}(t),3)]$$

Initial conditions to start smoothing are:

$$\hat{y}(0),1 = \hat{b}_o(0) - (\beta/\alpha)\hat{b}_1(0) + [\beta(1 +\beta)/\alpha^2]\hat{b}_2(0)$$

$$\hat{y}(0),2 = \hat{b}_o(0) - (2\beta/\alpha)\hat{b}_1(0) + [2\beta(1 + 2\beta)/\alpha^2]\hat{b}_2(0)$$

$$\hat{y}(0),3 = \hat{b}_o(0) - (3\beta/\alpha)\hat{b} (0) + [3\beta(1 + 3\beta)/\alpha^2]\hat{b}_2(0)$$

These exponential smoothing techniques are, essentially, methods of computing weighted moving averages. To be accurate, the smoothing constant and order of smoothing must be appropriate for the time-series being forecasted. The appropriateness of the smoothing constant and order of smoothing is determined based upon the mean average deviation (MAD) error of the forecasting model. The MAD error is the average of the sum of the absolute values of the errors between the forecast values and the actual values. The MAD error also varies depending upon the lead-time (i.e., one year in the future, two years in the future).

The optimum forecast model is that model which minimizes the MAD error for a specific data series and lead-time. The determination of an optimum model, based upon the minimum MAD error criteria, is a trial and error process. Therefore, the Honeywell TCAST Time-Series Forecasting Computer Program (Honeywell TCAST) was used to determine the optimum forecast model (optimum smoothing constant and order of smoothing) for the data to be analyzed. The TCAST program provides an error analysis for the input data and the orders of smoothing for a given lead-time at various α's. Because the TCAST program truncates the first five values in a series, the optimum forecast model for time-series containing a relatively few data points cannot be implemented through the program, but must be manually computed.

Forecast Confidence Interval

The forecast confidence interval (FCI) is that tolerance about a prediction point within which the actual value is expected to fall at a known probability. FCI is determined by the following relationship:

$$y = \hat{y}(t),L \pm K(MAD)$$

where y represents the derived upper and lower limits of the FCI; $\hat{y}(t)$ is the value forecast at time, t; L is the lead-time; K is a safety factor; and MAD is the mean absolute deviation.

Safety Factors

The safety factor, corresponding to a given probability that a sample will exceed a set level, can be found in the table below.

Probability	Normal K
0.00	∞
0.01	2.915
0.05	2.062
0.10	1.607
0.15	1.298
0.20	1.055
0.25	0.8454
0.30	0.6572
0.40	0.3176
0.50	0.0000

Sources: Lawrence, Captain Fredrick P., USAF Instructor in Quantitative Methods, Department of Quantitative Studies, School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB, Ohio. AFIT Course QM 5.32, "Statistics II," Class 1977A. Lectures 30 November through 3 December, 1976.

Honeywell Corporation. Series 6000/600/400/G-200 Time Series Forecasting Implementation Guide. Order No. BQ08. Minneapolis: Honeywell Information Systems Incorporated, 1973.

APPENDIX C

SOURCES

Data Sources

Indicator	Title/Source*
S01	Number of Building Permits Issued, ROE, Schedule 47, 1967 through 1975.
S02	Dollar Value of Building Permits Issued, ROE, Schedule 47, 1967 through 1975.
S03	Total Bank Deposits, C&C, 1968 through 1975.
S04	Taxes Assessed Valuation, ROE, Schedule 39, 1976.
S05	Tax Rate, ROE, Schedule 39, 1976.
S06	Civic Center and Swimming Pool Expenditures, ROE, Schedule 42, 1974 and 1975.
S07	Fire Protection Employees, ROE, Schedule 47, 1967 through 1975.
S08	General Government Expenditures, ROE, Schedule 42, 1974 and 1975.
S09	Health and Hospital Expenditures, ROE, Schedule 42, 1974 and 1975.
S10	Local Media: TV Stations, Radio Stations, Movie Theaters, and Drive-in Theaters, Laredo Telephone Directory, 1965 through 1975.
S11	Miles of Storm Sewers, ROE, Schedule 47, 1967 through 1975.
S12	Miles of Sanitary Sewers, ROE, Schedule 47, 1967 through 1975.
S13	Miles of Graded Streets, ROE, Schedule 47, 1967 through 1975.
S14	Miles of Paved Streets, ROE, Schedule 47, 1967 through 1975.

Indicator	Title/Source*
S15	Full Time Municipal Employees, ROE, Schedule 47, 1967 through 1975.
S16	Part Time Municipal Employees, ROE, Schedule 47, 1967 through 1975.
S17	Number of Registered Voters, Personal Interview: Fernando Piñon and William Bouldin of The Laredo Times, Dec. 1967.
S18	Percent Voting in Presidential Elections, Personal Interview: Fernando Piñon and William Bouldin of The Laredo Times, Dec. 1976.
S19	Public Safety Expenditures, ROE, Schedule 42, 1974 and 1975.
S20	Public Welfare Expenditures, ROE, Schedule 42, 1974 and 1975.
S21	Dollars of Retail Sales, COC, 1968 through 1975.
S22	Sanitation Expenditures, ROE, Schedule 42, 1974 and 1975.
S23	Number of Street Lights, ROE, Schedule 47, 1967 through 1975.
S24	Unemployment Rate, Texas Unemployment Commission, "Monthly Unemployment Rates."
S25	Department of Agriculture Outlays, CPS, 1968 through 1975.
S26	Department of Commerce Outlays, CPS, 1968 through 1975.
S27	Department of Defense Civilian Pay, CPS, 1968 through 1975.
S28	Department of Defense Military Active Duty Pay, CPS, 1968 through 1975.

Indicator	Title/Source*
S29	Department of Defense Reserve and National Guard Pay, CPS, 1968 through 1975.
S30	Department of Defense Military Retired Pay, CPS, 1968 through 1975.
S31	Department of Defense Prime Supply Contracts, CPS, 1968 through 1975.
S32	Department of Defense Prime Service Contracts, CPS, 1968 through 1975.
S33	Department of Defense Prime Construction Contracts, CPS, 1968 through 1975.
S34	Department of Defense Contracts Less Than $10,000, CPS, 1968 through 1975.
S35	Department of Health, Education, and Welfare Outlays, CPS, 1968 through 1975.
S36	Department of Housing and Urban Development Outlays, CPS, 1968 through 1975.
S37	Department of Labor Outlays, CPS, 1968 through 1975.
S38	Number of Students Registered, ROE, Schedule 47, 1967 through 1975.
S39	Student Teacher Ratio, ROE, Schedule 47, 1967 through 1975.
S40	Water Quality, Coliform Increase, FORG, 1965 through 1975.
S41	Water Quality, Bacteria Increase, FORG, 1965 through 1975.
S42	Number of Fire Hydrants, ROE, Schedule 47, 1967 through 1975.
S43	Department of Transportation Outlays, CPS, 1968 through 1975.
S44	Civil Service Expenditures, CPS, 1968 through 1975.

Indicator	Title/Source*
S45	General Services Administration Expenditures, CPS, 1968 through 1975.
S46	Office of Economic Opportunity Expenditures, CPS, 1968 through 1975.
S47	Small Business Administration Expenditures, CPS, 1968 through 1975.
S48	Total Federal Outlays, Webb County, CPS, 1968 through 1975.
S49	Total Federal Outlays, Laredo, CPS, 1968 through 1975.
S50	Population, Laredo, ROE, Schedule 47, 1965 through 1975.
S51	Total Housing Construction Permits, All Types, CR, 1966 through 1975.
S52	Single Unit Housing Construction Permits, CR, 1966 through 1975.
S53	Five or More Unit Housing Construction Permits, CR, 1966 through 1975.
S54	Drug Arrests, DAP, 1976.
S55	Total Volumes in City Library, Letter Feb. 77 from Laredo Public Library, 1965 through 1975.
S56	Number of Doctors' Offices, C&C, 1965 through 1974.
S57	Number of Doctors' Employees, C&C, 1965 through 1974.
S58	Number of Taverns and Restaurant, C&C, 1965 through 1974.
S59	Number of Tavern and Restaurant Employees, C&C, 1965 through 1974.
S60	Number of Auto Dealers and Service Stations, C&C, 1965 through 1974.

Indicator	Title/Source*
S61	Number of Auto Dealer and Service Station Employees, C&C, 1965 through 1974.
S62	Number of General Merchandise Employees, C&C, 1965 through 1974.
S63	Number of General Merchandise Retail Stores, C&C, 1965 through 1974.
S64	Labor Force, COC, 1968 through 1975.
S65	Total Bank Assets, COC, 1966 and 1968 through 1975.
S66	Number of Wholesale Grocery Companies, C&C, 1965 through 1974.
S67	Number of Wholesale Grocery Employees, C&C, 1965 through 1974.
S68	Number of Trucking and Warehousing Companies, C&C, 1965 through 1974.
S69	Number of Trucking and Warehousing Employees, C&C, 1965 through 1974.
S70	Number of Urban Passenger Transport Employees, C&C, 1965 through 1974.
S71	Savings and Loan Total Assets, COC, 1971 through 1975.
S72	Motor Vehicle Registrations, COC, 1968 through 1975.
S73	Telephone Connections, COC, 1968 through 1975.
S74	Electrical Connections, COC, 1968 through 1975.
S75	Gas Connections, COC, 1968 through 1975.
S76	Water Connections, COC, 1968 through 1975.
S77	Students at Laredo Junior College, LJCYB, 1970 through 1975.

Indicator	Title/Source*
S78	Graduate Education Division Students at Laredo Junior College, LJCYB, 1970 through 1975.
S79	Total Police Hours Expended, LPDAR, 1968 through 1975.
S80	Total Police Assigned, LPDAR, 1969 through 1975.
S81	Percent Manned Laredo Police Force, LPDAR, 1969 through 1975.
S82	Total Traffic Accidents, LPDAR, 1967 through 1975.
S83	Total Guilty of Traffic Violations, LPDAR, 1967 through 1975.
S84	Total Arrests for Criminal Activity, LPDAR, 1967 through 1975.
S85	Dollars of Exports, COC, 1971 through 1975.
S86	Dollars of Imports, COC, 1971 through 1975.

*The following abbreviations are used throughout this appendix:

1. C&C, County and City Data Book.

2. COC, Laredo Chamber of Commerce Annual Reports.

3. CPS, Federal Information Exchange System County Program Summary.

4. CR, Construction Reports, Housing Authorized by Building Permits and Public Contracts.

5. DAP, South Texas Development Council Drug Abuse Plan.

6. FORG, Flow of the Rio Grande and Related Data.

7. LJCYB, Laredo Junior College Year Book.

8. LPDAR, Laredo Police Department Annual Report.

9. ROE, City of Laredo, Texas, Report of Examination.

APPENDIX D

OFFICIALS INTERVIEWED

Officials Interviewed

Major General (Ret.) Milton R. Adams
Laredo Chamber of Commerce

Mr. William Bouldin
Laredo Times Newspaper

Mr. A. J. Lopez
Assistant City Secretary, Laredo

Mr. Blas Martines
Community Development Council, Laredo

Ms. Letycia Palacios
Laredo Chamber of Commerce

Colonel (Ret.) Gaillard R. Peck
Airport Manager, Laredo

Mr. Fernando Piñon
Laredo Times Newspaper

Sergeant A. J. Romero
Records Bureau, Laredo Police Department

Mr. Frank Saldana
Texas Water Quality Board, Laredo

Mr. Luis F. Sosa
Deputy Fire Chief, Laredo

APPENDIX E

FACTOR/INDICATOR CORRELATION MATRIX

Factor/Indicator Correlation Matrix

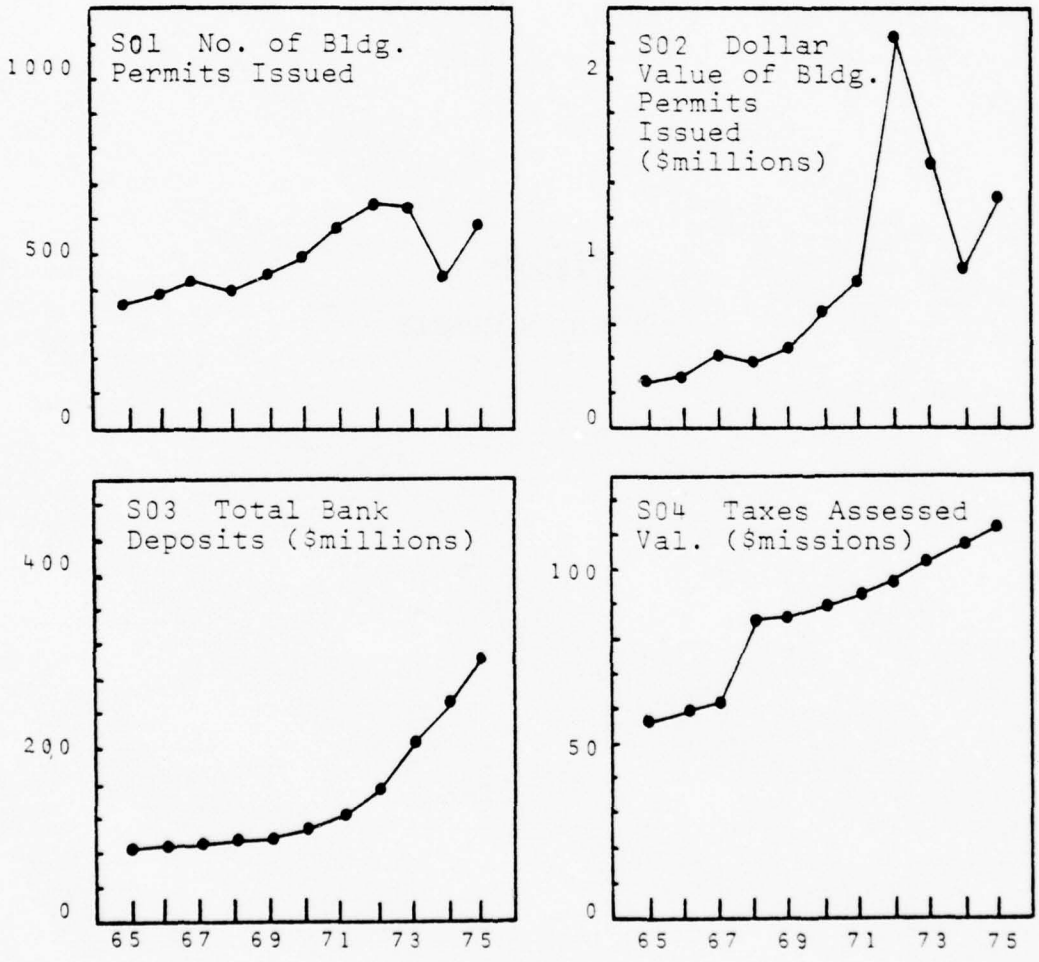
	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
S01	0.75482	-0.29777	0.29588	0.18645	0.24098	0.16526	0.05372	0.01610
S02	0.66664	-0.14385	0.40063	0.27088	0.32296	-0.06075	0.42962	0.02035
S03	0.78048	0.57085	0.40186	0.08210	0.08455	0.04366	0.02918	0.00797
S04	0.96976	0.16559	0.11947	-0.09265	0.01316	0.02573	0.07591	0.02876
S05	-0.98657	0.08609	0.01492	-0.03914	0.06325	0.00851	-0.02956	-0.00180
S06	0.89455	0.10413	0.32520	0.08224	0.01815	0.00479	-0.06761	-0.07941
S07	0.85999	0.35299	0.26319	-0.51857	-0.16345	0.28566	-0.54907	0.26359
S08	0.80685	0.53658	0.12816	0.09754	0.14369	0.07023	0.06217	-0.00993
S09	0.85963	0.40192	0.25129	0.11280	0.11233	-0.09296	0.02227	0.03754
S10	0.69021	0.31796	0.62939	0.01427	0.04145	0.04730	-0.08340	0.11479
S11	0.52368	0.79776	-0.08468	0.12349	0.13654	0.23266	0.00190	-0.02222
S12	0.75937	0.43448	0.43128	-0.01159	0.07370	0.03434	0.20244	-0.00919
S13	0.96937	0.21163	0.07526	0.01995	-0.00288	0.06947	0.06371	-0.01585
S14	0.90873	0.34876	0.16837	0.09840	-0.07788	-0.04956	0.08100	-0.03398
S15	0.82789	0.04649	0.15878	0.29839	0.28739	-0.02748	-0.27755	0.17100
S16	0.61523	0.56113	0.13475	-0.13442	0.39187	0.11698	-0.15812	0.27416
S17	0.89758	0.34424	0.25708	0.05787	0.04693	0.01979	0.04815	-0.00042
S18	-0.89656	-0.32684	-0.27657	-0.08236	-0.05717	0.00389	-0.04167	-0.00428
S19	0.87143	0.40680	0.19495	0.16179	0.01175	-0.08948	0.05272	0.01471
S20	0.85792	0.25677	0.30439	0.23982	-0.01477	-0.03249	0.20879	0.00043
S21	0.84813	0.43624	0.20916	0.10685	-0.05225	-0.03620	0.01982	0.06564
S22	0.79735	0.52629	0.20877	-0.03310	0.05659	-0.10502	0.05005	-0.02830
S23	0.97363	-0.11324	-0.10453	0.01632	-0.07771	-0.08512	-0.07512	-0.08747
S24	0.59219	0.68288	0.20865	0.26831	0.15862	0.13704	-0.01641	0.15933
S25	0.61857	0.71573	0.10391	0.15985	0.20751	0.10343	-0.01239	-0.03524
S26	0.48781	0.57228	-0.04673	0.39614	0.11521	0.56440	0.06670	-0.07757
S27	-0.84573	-0.98033	0.05938	0.04972	-0.01933	-0.15178	0.07185	0.04003
S28	0.27244	-0.94778	0.02093	0.07643	-0.00590	-0.03051	0.11863	-0.02393
S29	0.93946	0.13348	0.08304	0.24716	-0.09623	0.11251	-0.07842	0.05618
S30	0.77153	0.44342	0.39444	0.18196	0.07688	0.04216	0.05796	0.07982
S31	-0.24562	-0.81166	-0.18295	-0.95621	0.04156	-0.09905	-0.05127	-0.01287
S32	-0.33924	-0.90782	-0.16556	-0.01298	-0.03617	-0.89589	-0.14266	0.02274
S33	-0.94521	0.02806	-0.02814	-0.15088	0.12513	0.15754	0.01566	0.20361
S34	-0.17784	-0.95665	0.16092	0.89178	0.08828	-0.04939	0.07380	-0.03976
S35	0.82227	0.47995	0.18340	0.13402	0.13460	0.13186	0.87110	-0.02631
S36	0.39646	-0.38276	0.36504	0.20767	0.47123	-0.10003	0.57956	0.08227
S37	0.78628	0.28136	-0.06221	0.34814	0.28013	0.25113	0.16858	-0.13121
S38	0.96736	0.13235	0.17853	0.03960	0.08161	-0.08635	0.11355	-0.01722
S39	-0.46135	-0.45665	-0.69585	-0.05134	-0.19013	0.08497	0.02319	-0.20993
S40	0.52992	-0.46071	0.21629	0.31376	-0.39535	0.02947	-0.40891	0.06014
S41	-0.88221	-0.15486	0.12465	-0.02142	-0.95959	0.08434	-0.11553	0.12813
S42	0.82455	0.01697	0.45964	-0.02430	0.14525	-0.27115	-0.05495	0.08842
S43	0.64276	0.51653	0.14802	0.14031	0.09761	-0.12086	0.47631	0.10894

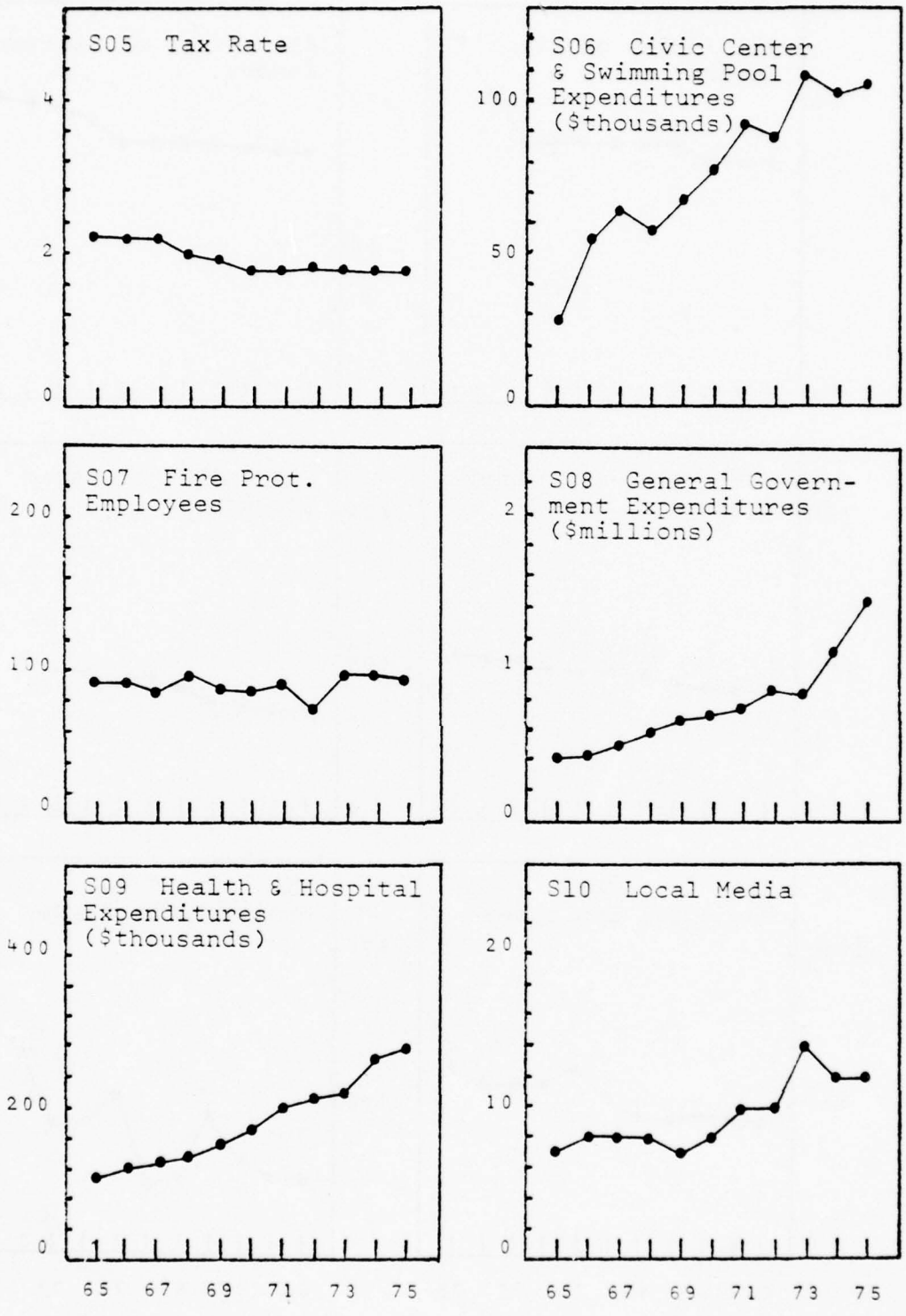
	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
S44	0.73229	0.59803	0.26603	0.12976	0.06781	0.09770	0.03685	-0.01361
S45	0.00443	0.18778	-0.22268	-0.02229	0.00638	-0.07021	0.03594	-0.94529
S46	-0.39710	-0.71336	-0.05519	-0.44678	-0.09836	0.05397	-0.03749	0.34155
S47	0.61463	-0.01688	0.76276	0.07346	0.05942	-0.04490	0.10568	0.04563
S48	0.80746	0.04215	0.34639	0.24135	0.27605	0.24223	0.18128	-0.00739
S49	0.32387	0.47219	-0.34193	0.04173	-0.39089	0.47238	0.33208	-0.22885
S50	0.92858	0.17275	0.27914	0.07570	-0.10738	-0.03747	-0.01071	-0.02930
S51	0.58267	-0.54643	0.33457	0.43557	0.13218	0.14899	-0.01504	0.11727
S52	0.46359	0.11584	-0.32988	0.61112	0.31255	0.42542	0.06703	0.06093
S53	0.46938	-0.66432	0.52028	0.22659	0.01502	-0.02170	-0.04905	0.10145
S54	0.47565	0.87367	-0.00974	-0.00031	0.04079	-0.00894	-0.07589	0.03304
S55	0.90752	0.31569	0.24298	0.05120	0.05055	0.04935	0.05867	-0.01632
S56	0.90902	0.32309	0.10904	0.05518	0.08795	-0.06106	-0.03866	-0.03281
S57	0.76047	0.43097	0.43844	0.00708	0.12253	0.01742	0.16470	0.01484
S58	0.03374	0.90884	0.08807	0.17162	0.15689	0.12417	-0.03124	-0.29406
S59	0.22196	0.85959	0.22913	-0.35353	-0.15643	0.05400	0.04359	-0.03579
S60	0.56167	0.81266	0.03016	0.02913	-0.01062	0.05168	-0.05816	-0.06658
S61	0.24572	0.73152	0.26948	0.45024	-0.20912	-0.10318	0.22450	-0.10574
S62	0.77158	0.55002	0.23732	0.17180	-0.03078	-0.06437	0.08284	0.01189
S63	-0.49882	-0.39959	-0.19214	-0.29602	0.36142	0.25558	0.19171	0.45773
S64	-0.89625	-0.64936	-0.67750	0.10830	0.15573	0.12925	0.07559	-0.05674
S65	0.76485	0.51934	0.35938	0.06261	0.07203	0.07278	0.03835	0.00093
S66	-0.40232	-0.27183	-0.73284	-0.21491	0.20488	0.03197	0.09852	0.06089
S67	0.65096	-0.19515	-0.50756	0.07688	0.20546	-0.25244	0.08075	-0.14236
S68	0.54912	-0.12971	0.67358	0.14772	0.35882	0.03879	-0.10348	0.21348
S69	0.64983	0.17854	0.60638	0.10029	-0.16616	0.12088	0.09301	-0.04357
S70	-0.71964	-0.09614	0.34901	-0.23878	0.15329	0.29793	-0.01602	0.21556
S71	0.87385	0.39674	0.21990	0.10478	0.09593	0.08046	0.04865	-0.00095
S72	0.88875	0.00010	0.27541	0.04737	-0.15151	-0.23885	-0.21376	-0.04735
S73	0.95805	0.20297	0.11101	0.09818	0.07109	-0.02997	0.07373	-0.01822
S74	0.91371	0.38003	0.21582	0.10030	0.10845	0.00478	0.05896	0.01309
S75	0.79841	0.50595	0.20037	0.19028	0.15360	0.02503	0.05285	0.05588
S76	0.91366	0.27795	0.24635	0.10696	0.09288	0.00608	0.07002	0.01522
S77	0.61284	0.37557	0.60876	0.06519	-0.05293	0.29428	-0.04872	-0.06304
S78	0.71981	0.42508	0.27946	0.28748	0.23811	0.27153	0.05919	-0.02753
S79	0.71380	0.15815	0.11882	0.33975	0.56253	-0.05458	-0.08091	0.12579
S80	-0.32552	0.24936	-0.65950	0.24965	0.08651	0.52534	-0.20251	-0.09188
S81	-0.47959	0.15359	-0.68033	0.17191	-0.02215	0.46523	-0.15782	-0.10221
S82	0.65977	0.68527	0.29199	0.06776	-0.02711	0.04194	-0.00675	0.04154
S83	-0.22219	0.23922	-0.01310	0.02470	-0.15025	0.90098	-0.11388	0.19268
S84	0.87857	-0.17969	0.29663	-0.01828	-0.01069	-0.31538	-0.02318	0.08153
S85	0.62887	0.73223	0.25234	0.01424	0.02789	0.05094	-0.00535	0.00288
S86	0.72028	0.59814	0.33044	0.07560	0.06185	0.04862	0.03559	-0.00324

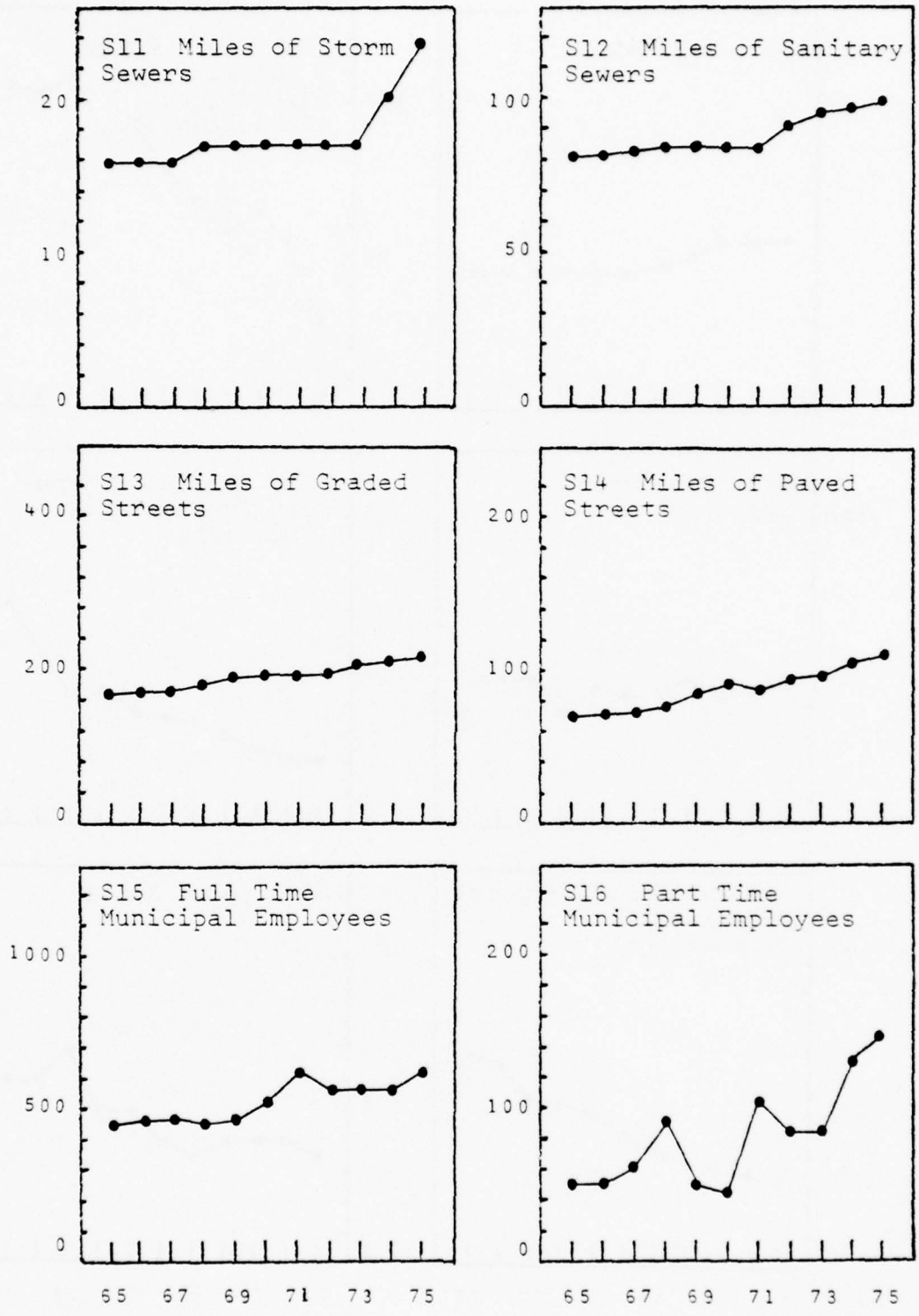
APPENDIX F

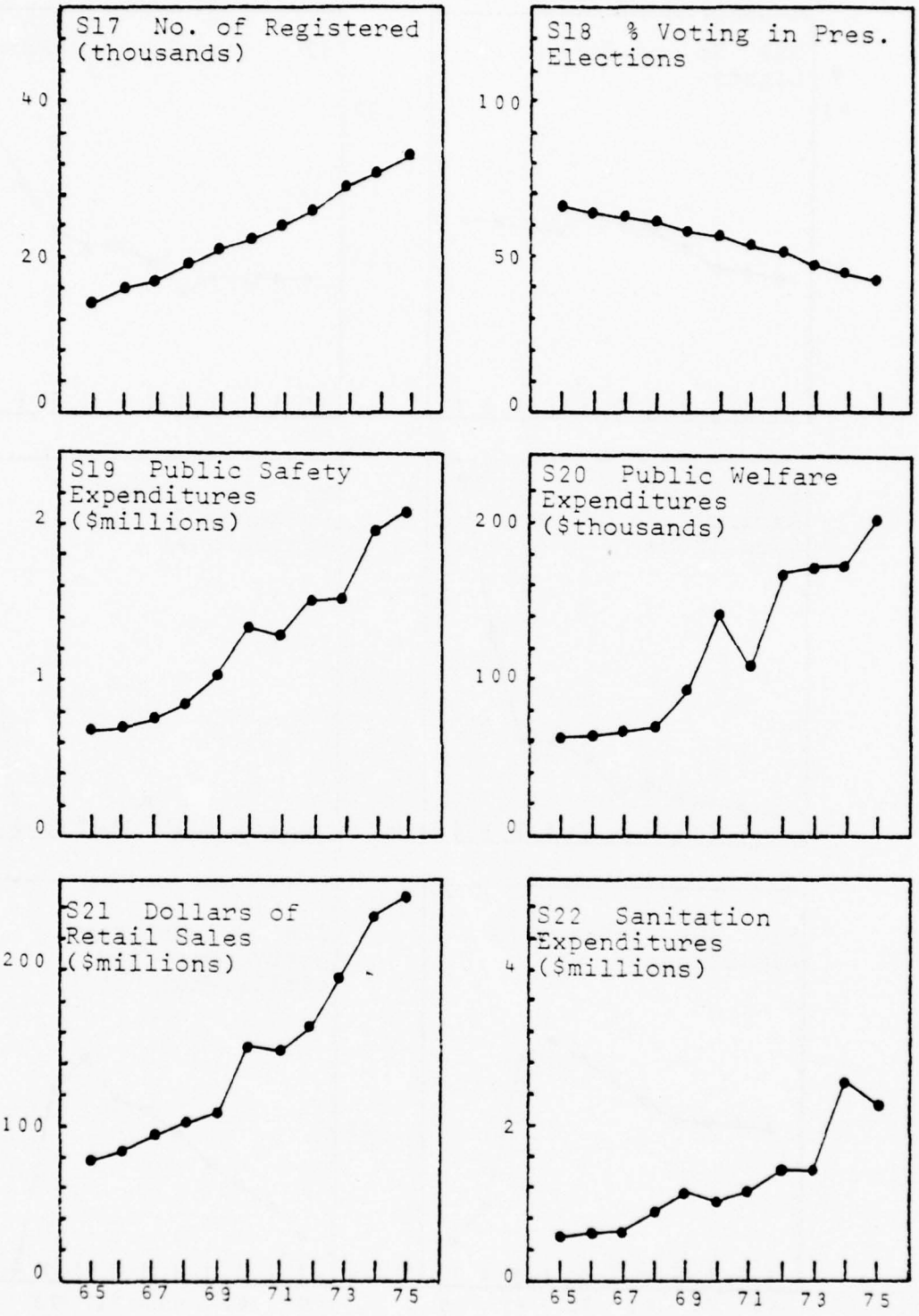
INDICATOR CHARTS

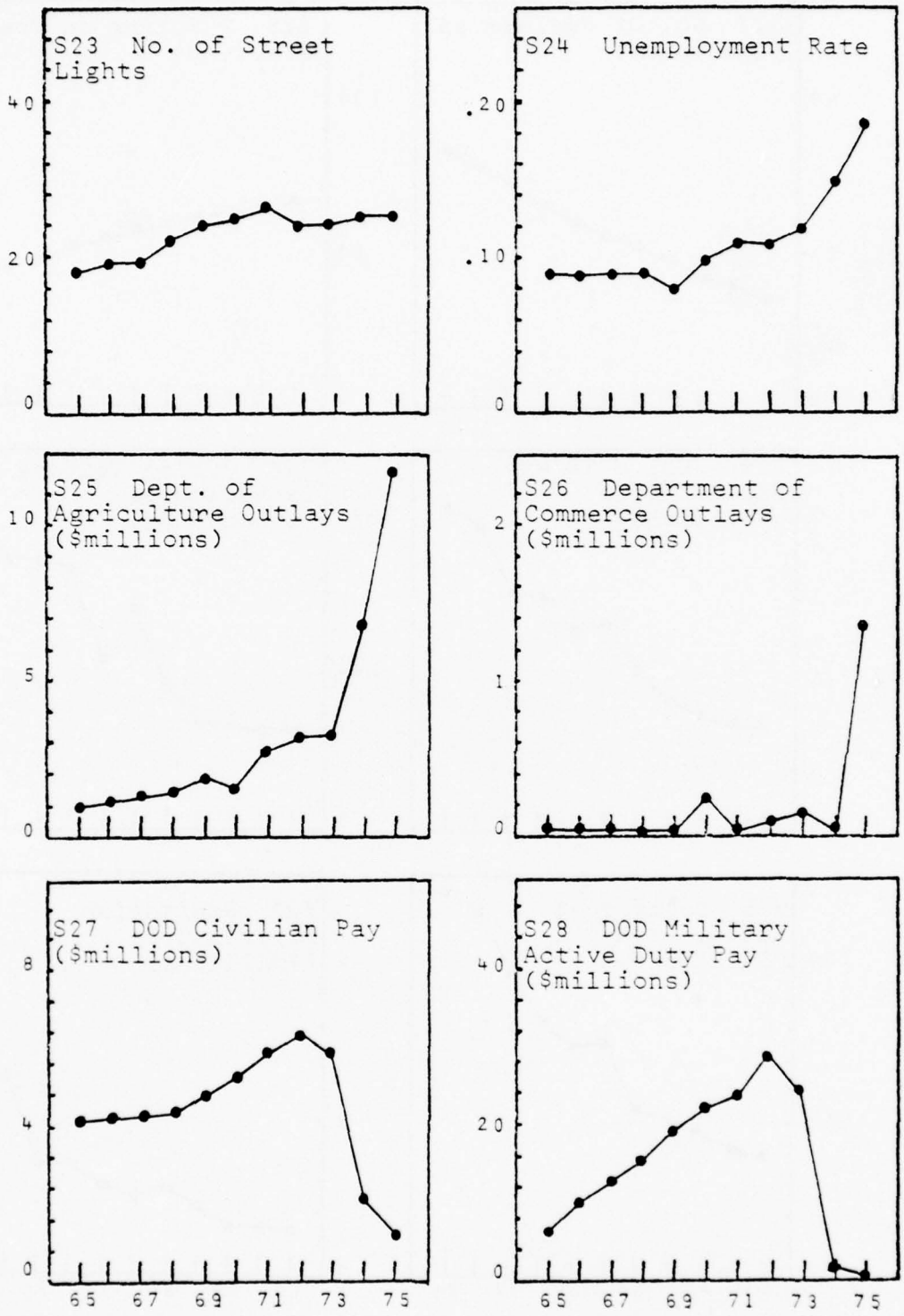
Indicator Charts

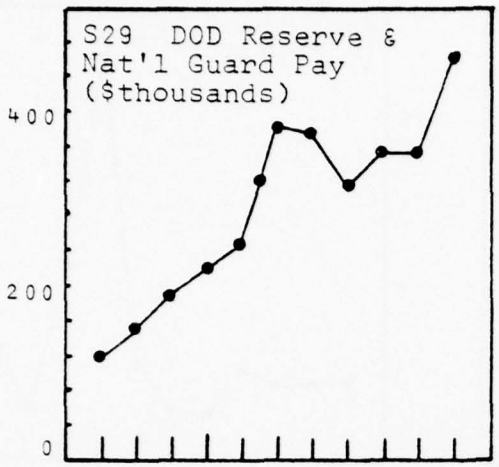


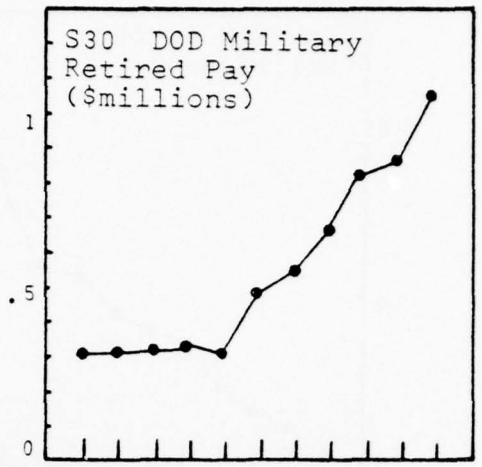

S05 Tax Rate
4
2
0
S06 Civic Center & Swimming Pool Expenditures ($thousands)
100
50
0
S07 Fire Prot. Employees
200
100
0
S08 General Government Expenditures ($millions)
2
1
0
S09 Health & Hospital Expenditures ($thousands)
400
200
0
S10 Local Media
20
10
0
65 67 69 71 73 75
65 67 69 71 73 75

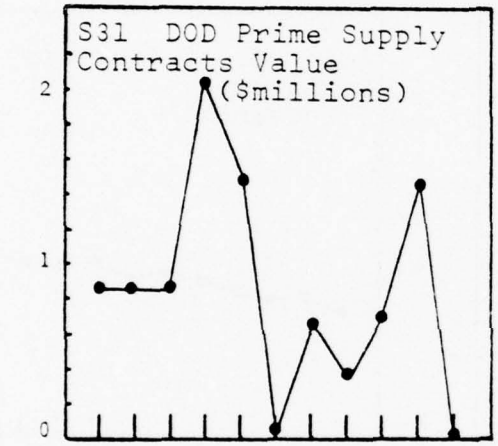

S11 Miles of Storm Sewers
20
10
0
S12 Miles of Sanitary Sewers
100
50
0
S13 Miles of Graded Streets
400
200
0
S14 Miles of Paved Streets
200
100
0
S15 Full Time Municipal Employees
1000
500
0
S16 Part Time Municipal Employees
200
100
0
65 67 69 71 73 75
65 67 69 71 73 75

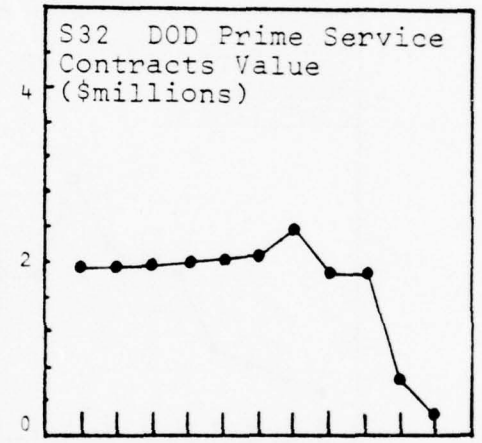

S17 No. of Registered (thousands)
40
20
0
S18 % Voting in Pres. Elections
100
50
0
S19 Public Safety Expenditures ($millions)
2
1
0
S20 Public Welfare Expenditures ($thousands)
200
100
0
S21 Dollars of Retail Sales ($millions)
200
100
0
65 67 69 71 73 75
S22 Sanitation Expenditures ($millions)
4
2
0
65 67 69 71 73 75

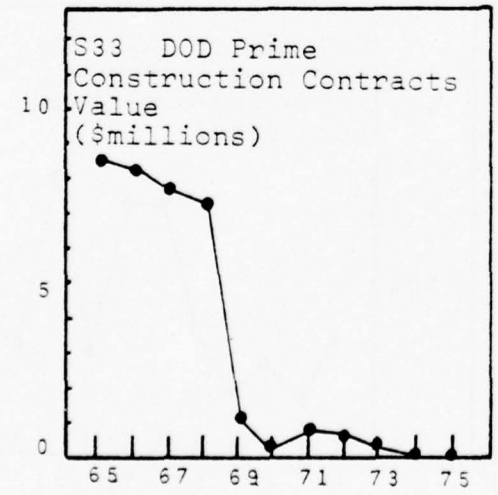

S23 No. of Street Lights
40
20
0
S24 Unemployment Rate
.20
.10
0
S25 Dept. of Agriculture Outlays ($millions)
10
5
0
S26 Department of Commerce Outlays ($millions)
2
1
0
S27 DOD Civilian Pay ($millions)
8
4
0
65 67 69 71 73 75
S28 DOD Military Active Duty Pay ($millions)
40
20
0
65 67 69 71 73 75

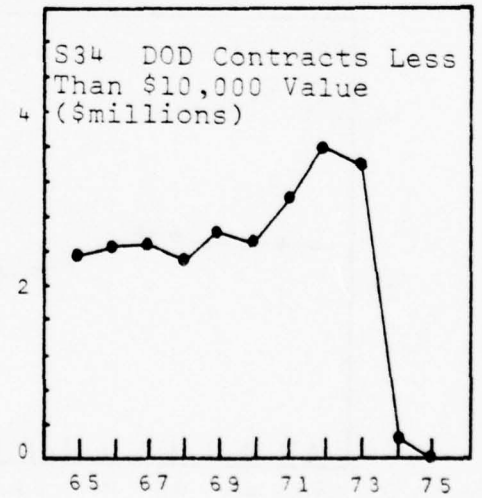

S29 DOD Reserve & Nat'l Guard Pay ($thousands)
400
200
0

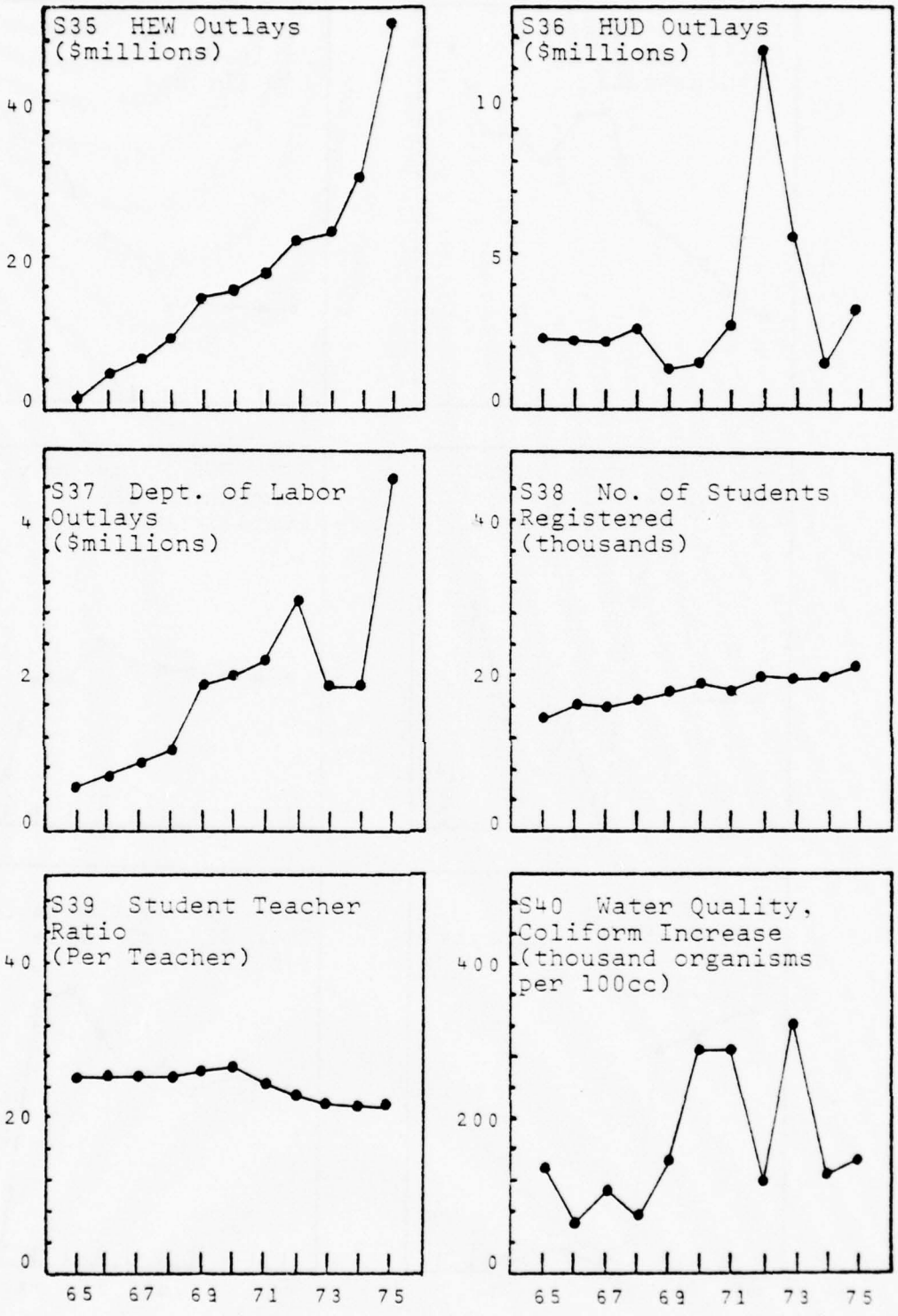

S30 DOD Military Retired Pay ($millions)
1
.5
0

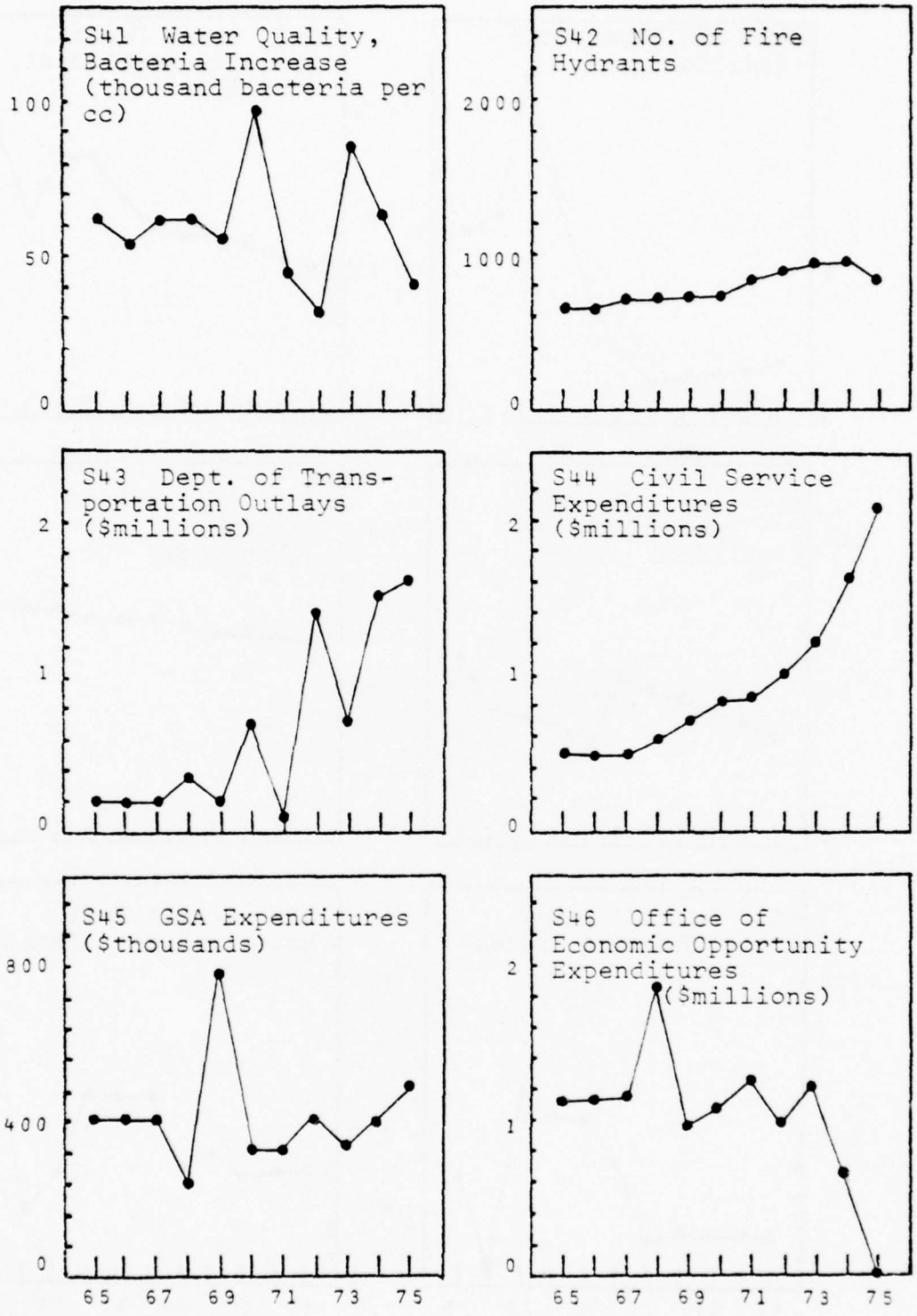

S31 DOD Prime Supply Contracts Value ($millions)
2
1
0

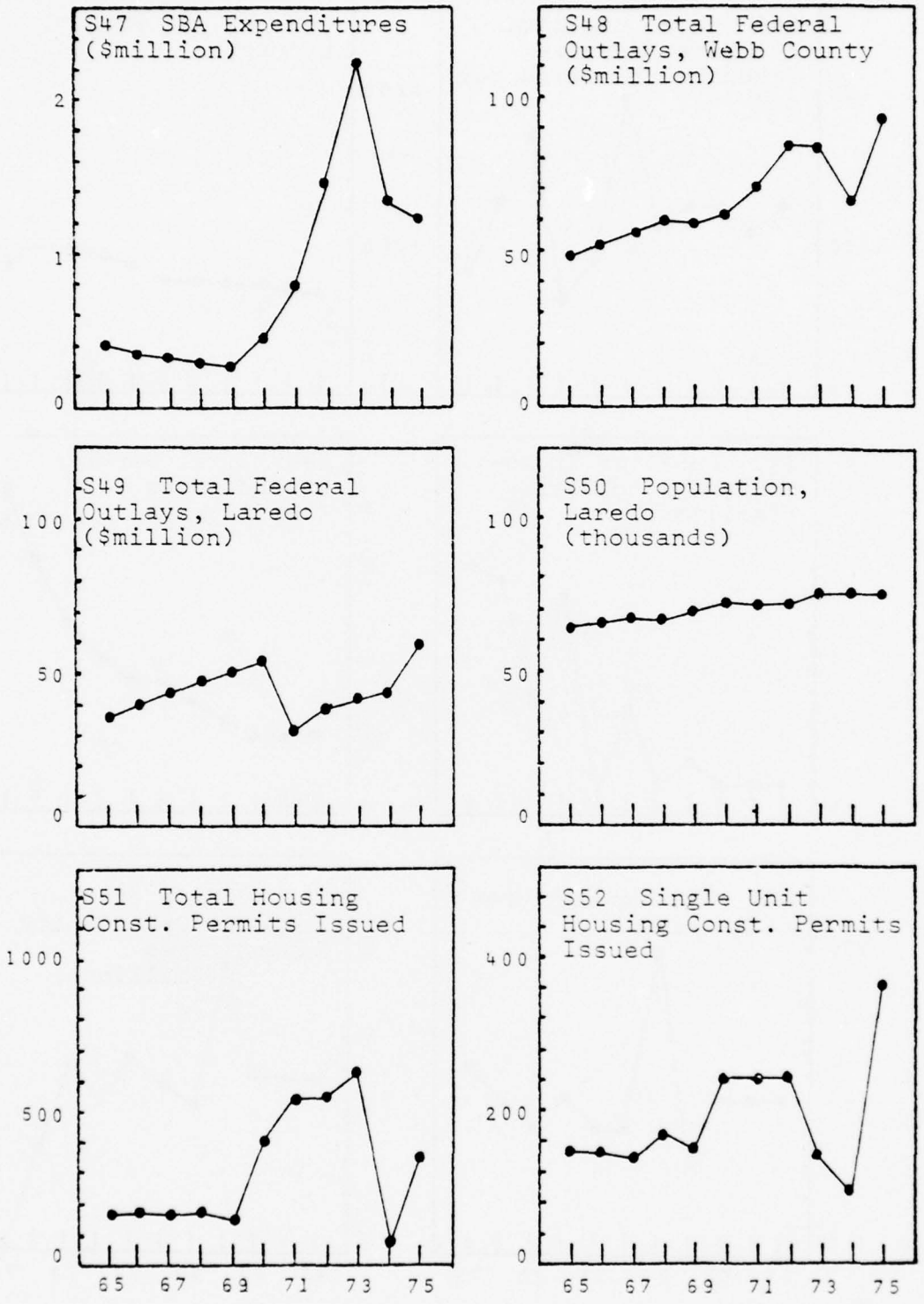

S32 DOD Prime Service Contracts Value ($millions)
4
2
0

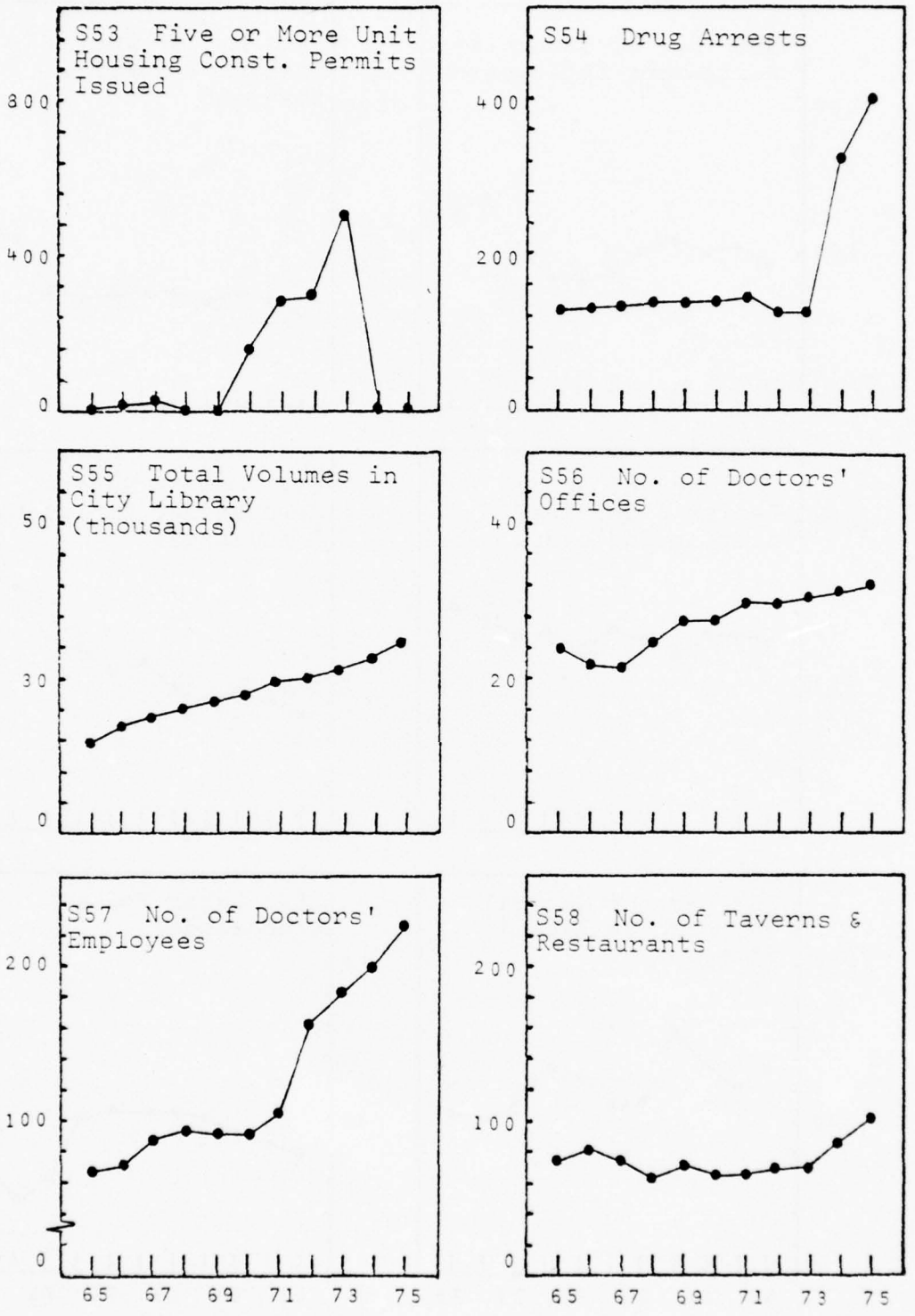

S33 DOD Prime Construction Contracts Value ($millions)
10
5
0
65
67
69
71
73
75

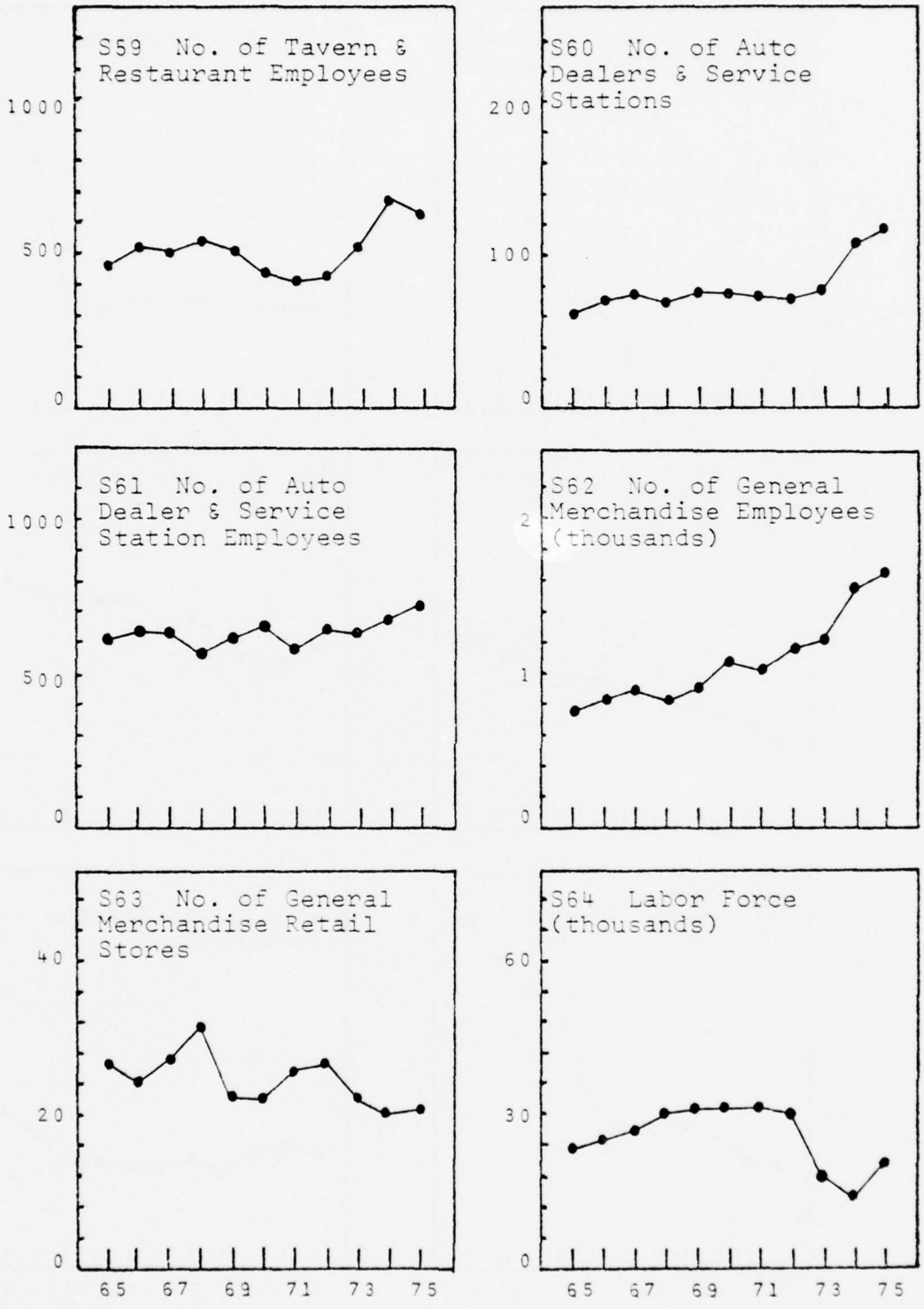

S34 DOD Contracts Less Than $10,000 Value ($millions)
4
2
0
65
67
69
71
73
75

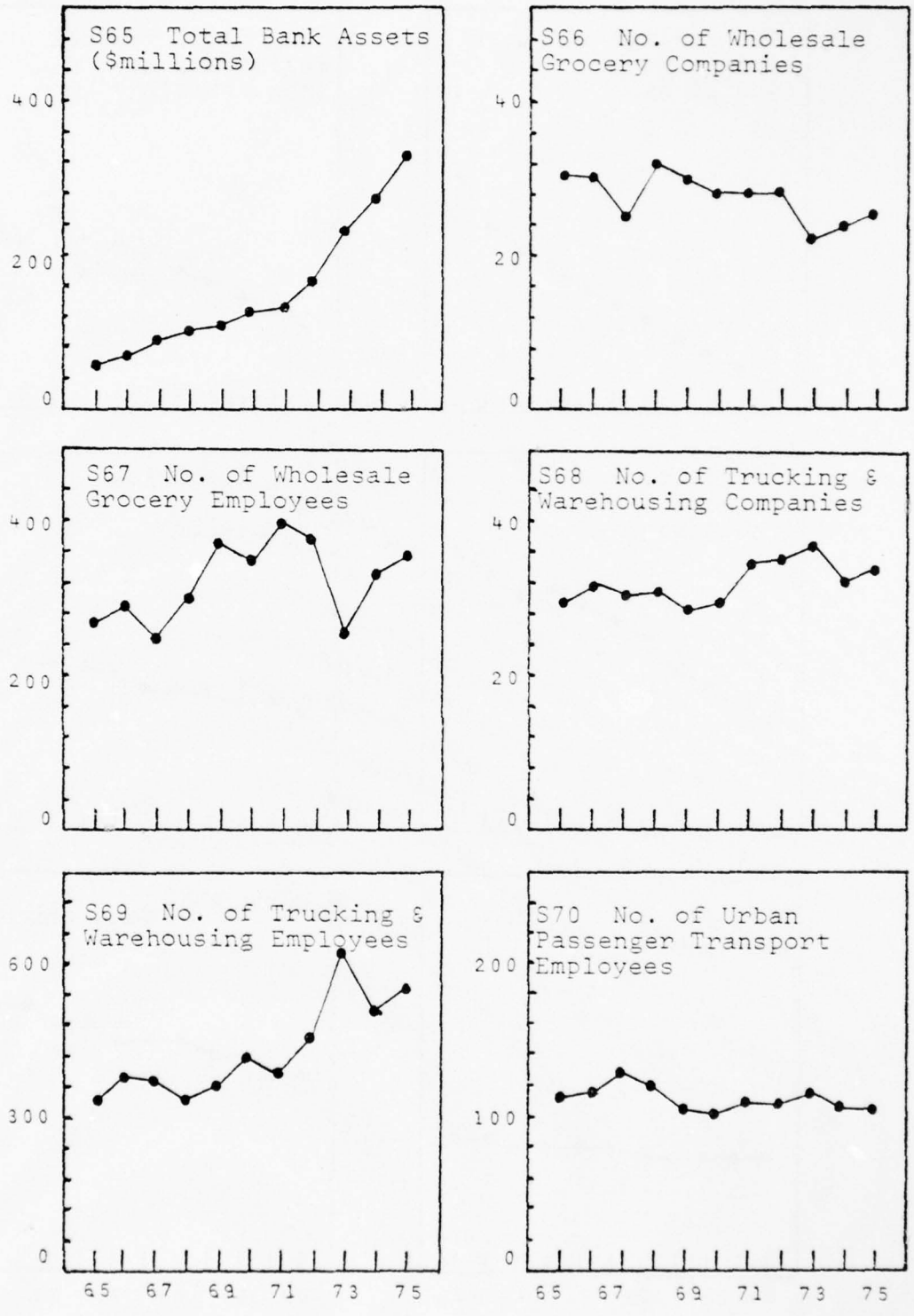

S35 HEW Outlays ($millions)
40
20
0
S36 HUD Outlays ($millions)
10
5
0
S37 Dept. of Labor Outlays ($millions)
4
2
0
S38 No. of Students Registered (thousands)
40
20
0
S39 Student Teacher Ratio (Per Teacher)
40
20
0
S40 Water Quality, Coliform Increase (thousand organisms per 100cc)
400
200
0
65 67 69 71 73 75
65 67 69 71 73 75

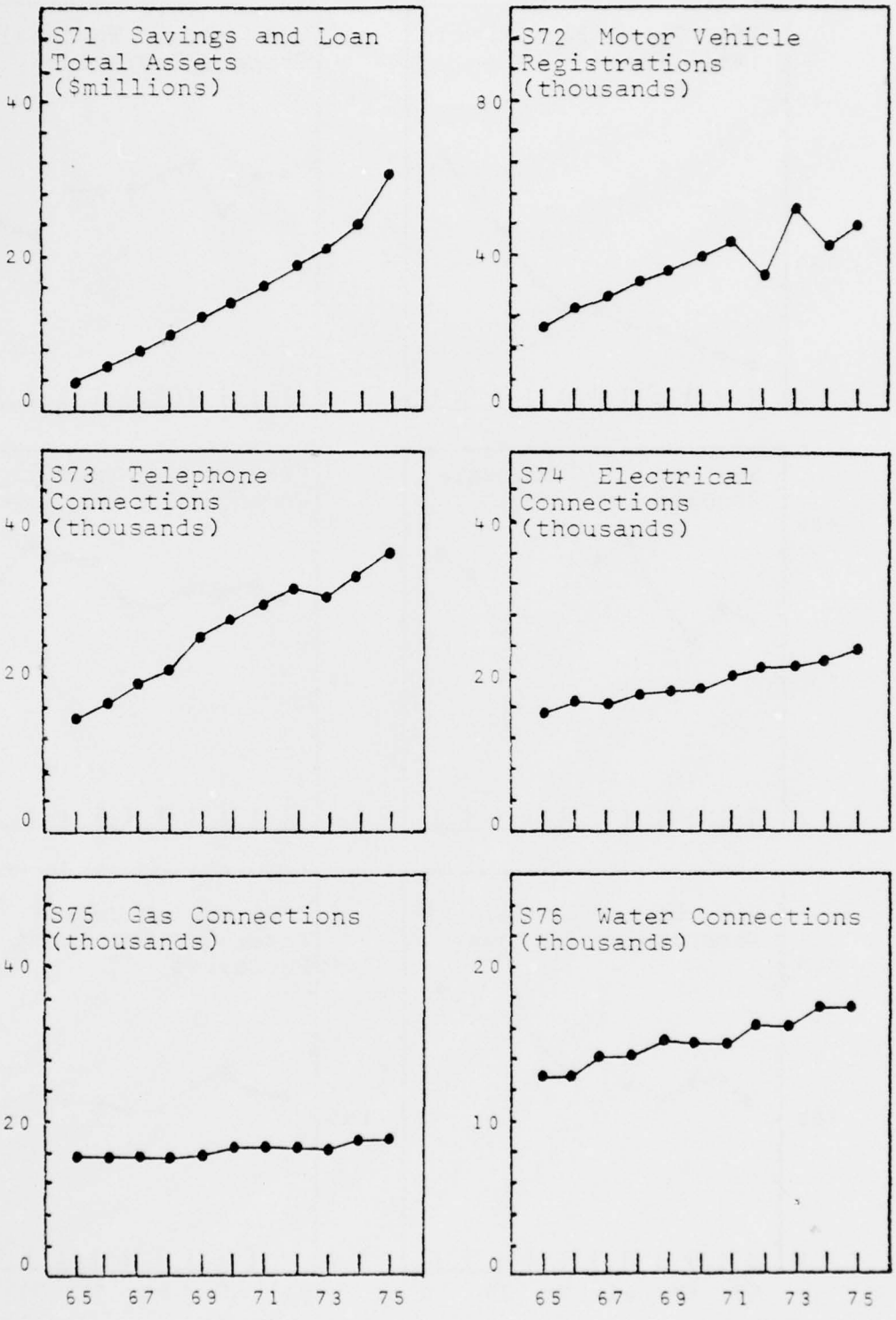

S41 Water Quality, Bacteria Increase (thousand bacteria per cc)
100
50
0
S42 No. of Fire Hydrants
2000
1000
0
S43 Dept. of Transportation Outlays ($millions)
2
1
0
S44 Civil Service Expenditures ($millions)
2
1
0
S45 GSA Expenditures ($thousands)
800
400
0
65 67 69 71 73 75
S46 Office of Economic Opportunity Expenditures ($millions)
2
1
0
65 67 69 71 73 75

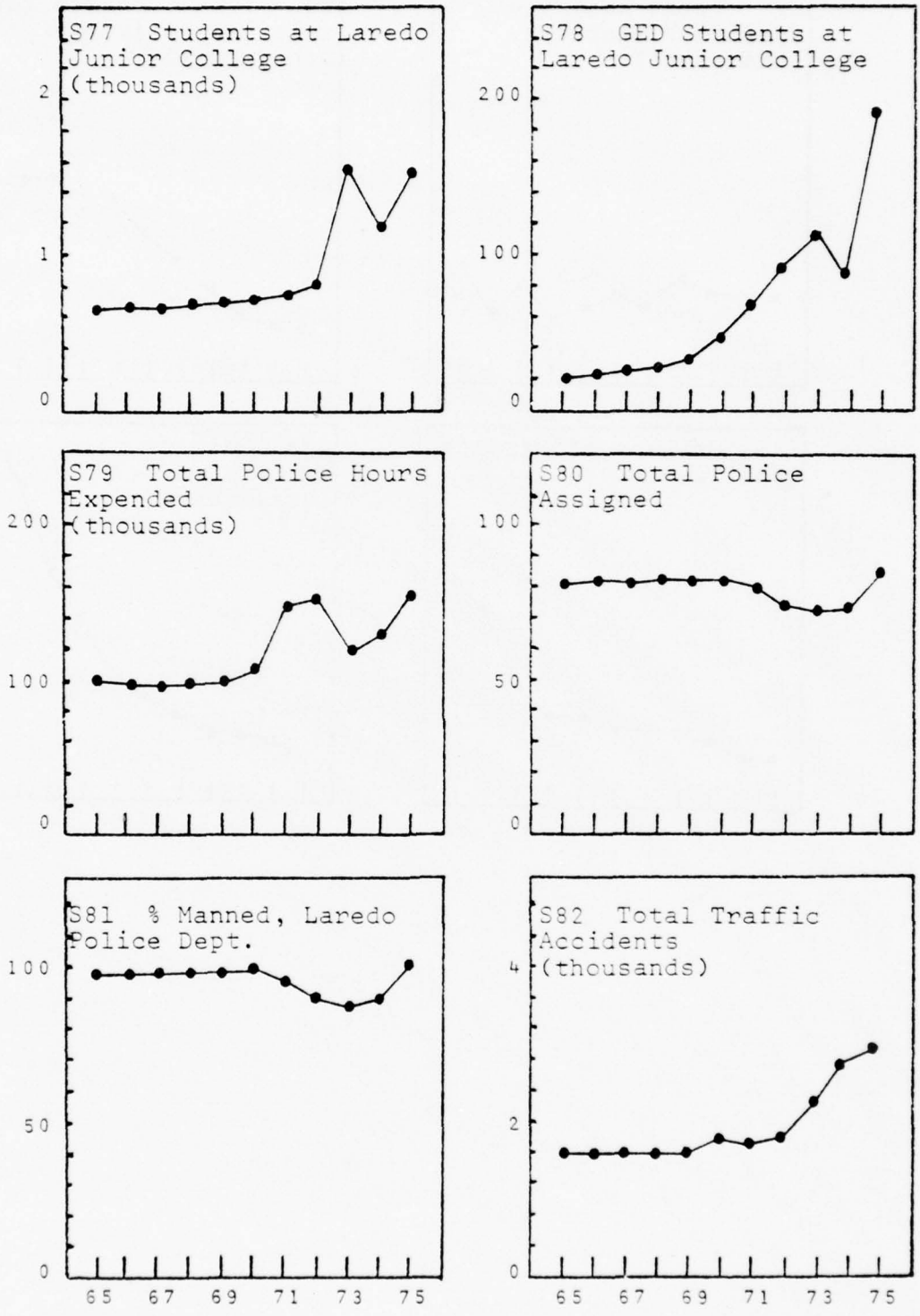

S47 SBA Expenditures ($million)
2
1
0
S48 Total Federal Outlays, Webb County ($million)
100
50
0
S49 Total Federal Outlays, Laredo ($million)
100
50
0
S50 Population, Laredo (thousands)
100
50
0
S51 Total Housing Const. Permits Issued
1000
500
0
65 67 69 71 73 75
S52 Single Unit Housing Const. Permits Issued
400
200
0
65 67 69 71 73 75

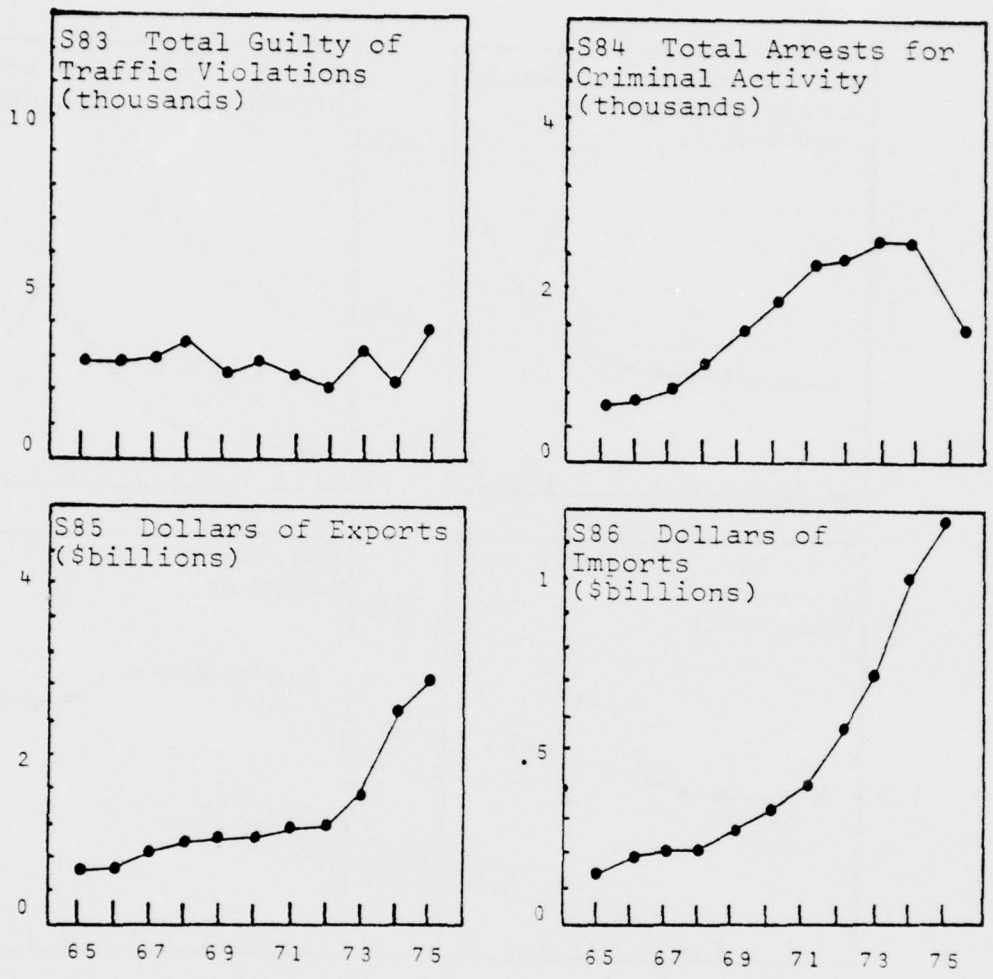

S53 Five or More Unit Housing Const. Permits Issued
800
400
0
S54 Drug Arrests
400
200
0
S55 Total Volumes in City Library (thousands)
50
30
0
S56 No. of Doctors' Offices
40
20
0
S57 No. of Doctors' Employees
200
100
0
65 67 69 71 73 75
S58 No. of Taverns & Restaurants
200
100
0
65 67 69 71 73 75


S59 No. of Tavern & Restaurant Employees
1000
500
0
S60 No. of Auto Dealers & Service Stations
200
100
0
S61 No. of Auto Dealer & Service Station Employees
1000
500
0
S62 No. of General Merchandise Employees (thousands)
2
1
0
S63 No. of General Merchandise Retail Stores
40
20
0
S64 Labor Force (thousands)
60
30
0
65 67 69 71 73 75
65 67 69 71 73 75


S65 Total Bank Assets ($millions)
400
200
0
S66 No. of Wholesale Grocery Companies
40
20
0
S67 No. of Wholesale Grocery Employees
400
200
0
S68 No. of Trucking & Warehousing Companies
40
20
0
S69 No. of Trucking & Warehousing Employees
600
300
0
S70 No. of Urban Passenger Transport Employees
200
100
0
65 67 69 71 73 75
65 67 69 71 73 75


S71 Savings and Loan Total Assets ($millions)
40
20
0
S72 Motor Vehicle Registrations (thousands)
80
40
0
S73 Telephone Connections (thousands)
40
20
0
S74 Electrical Connections (thousands)
40
20
0
S75 Gas Connections (thousands)
40
20
0
S76 Water Connections (thousands)
20
10
0
65 67 69 71 73 75
65 67 69 71 73 75


S77 Students at Laredo Junior College (thousands)
2
1
0
S78 GED Students at Laredo Junior College
200
100
0
S79 Total Police Hours Expended (thousands)
200
100
0
S80 Total Police Assigned
100
50
0
S81 % Manned, Laredo Police Dept.
100
50
0
S82 Total Traffic Accidents (thousands)
4
2
0
65 67 69 71 73 75
65 67 69 71 73 75


S83 Total Guilty of Traffic Violations (thousands)
10
5
0
S84 Total Arrests for Criminal Activity (thousands)
4
2
0
S85 Dollars of Exports ($billions)
4
2
0
65 67 69 71 73 75
S86 Dollars of Imports ($billions)
1
.5
0
65 67 69 71 73 75

APPENDIX G

SAMPLE FACTOR PROGRAM

Sample Factor Program

```
0010#$,R(SL) :,$,16;:,16
0020$:IDENT:WP1191,AFIT/SLG 77A CARDINALE KORN
0030$:SELECT:SPSS/BIOSPSS
0040$:LIMITS:,85K
0050$:PRMFL:15,R/W,S,77A72/FACSCOR
0060RUN NAME:FACTOR ANALYSIS ,VARIMAX,FACSCOR
0070INPUT MEDIUM:CARD
0080VARIABLE LIST:S01 TO S86
0090INPUT FORMAT:FREEFIELD
0100N OF CASES:11
0110VAR LABELS:S01,NO OF BUILDING PERMITS/
0120:S02,BUILDING PERMIT COST/
0130:S03,BANK DEPOSITS/
0140:S04,TAXES ASSESSED VALUATION/
0150:S05,TAX RATE/
0160:S06,CIVIC CENTER & SWIMMING POOL EXPENSES/
0170:S07,FIRE PROTECTION MANNING/
0180:S08,GENERAL GOVERNMENT EXPENDITURES LOCAL/
0190:S09,HEALTH & HOSPITAL EXPENDITURES/
0200:S10,LOCAL MEDIA/
0210:S11,MILES OF STORM SEWERS/
0220:S12,MILES OF SANITARY SEWERS/
0230:S13,MILES OF GRADED STREETS/
0240:S14,MILES OF PAVED STREETS/
0250:S15,FULL TIME MUNICIPAL EMPLOYEES/
0260:S16,NO OF PART TIME EMPLOYEES/
0270:S17,REGISTERED VOTERS/
0280:S18,% VOTING IN PRESIDENTIAL ELECT/
0290:S19,PUBLIC SAFETY EXPENDITURES/
0300:S20,PUBLIC WELFARE EXPENDITURES/
0310:S21,DOLLARS OF RETAIL SALES/
0320:S22,SANITATION EXPENDITURES/
0330:S23,NO OF STREET LIGHTS/
0340:S24,UNEMPLOYMENT RATE/
0350:S25,DEPT OF AGRICULTURE OUTLAYS NC/
0360:S26,DEPT OF COMMERCE OUTLAYS NC/
0370:S27,DOD CIVILIAN PAY NC/
0380:S28,DOD MILITARY ACTIVE DUTY PAY NC/
0390:S29,DOD RESERVE & NATIONAL GUARD PAY NC/
0400:S30,DOD MILITARY RETIRED PAY NC/
0410:S31,DOD PRIME SUPPLY CONTRACTS NC/
```

```
0420;S32,DOD PRIME SERVICE CONTRACTS NC/
0430;S33,DOD PRIME CONSTRUCTION CONTRACTS NC/
0440;S34,DOD CONTRACTS < $10,000/
0450;S35,HEW OUTLAYS  NC/
0460;S36,HUD OUTLAYS/
0470;S37,DEPARTMENT OF LABOR OUTLAYS/
0480;S38,TOTAL REGISTERED IN SCHOOLS/
0490;S39,STUDENT TEACHER RATIO/
0500;S40,WATER QUALITY, COLIFORM INCREASE/
0510;S41,WATER QUALITY, BACTERIA/
0520;S42,NO OF FIRE HYDRANTS/
0530;S43,DEPT OF TRANS OUTLAYS, NC/
0540;S44,CIVIL SERVICE EXPENDITURES , NC/
0550;S45,GSA EXPENDITURES, NC/
0560;S46,OFFICE OF ECONOMIC OPPORTUNITY, NC/
0570;S47,SBA EXPENDITURES, NC/
0580;S48,TOTAL FEDERAL OUTLAYS, NC/
0590;S49,TOTAL FEDERAL OUTLAYS, LAREDO/
0600;S50,POPULATION, LAREDO/
0610;S51,ALL HOUSING CONSTRUCTION PERMITS/
0620;S52,SINGLE UNIT CONSTRUCTION PERMITS/
0630;S53,5+ UNITS,CONSTRUCTION PERMITS/
0640;S54,DRUG ARRESTS NC/
0650;S55,TOTAL VOLUMNS IN LIBRARY/
0660;S56,NO OF DOCTOR'S OFFICES/
0670;S57,NO OF DOCTOR'S EMPLOYEES/
0680;S58,NO OF TAVERNS & RESTAURANTS/
0690;S59,EMPLOYEES FOR BARS & RESTAURANTS/
0700;S60,AUTO DEALERS & SERVICE STATIONS/
0710;S61,NO OF AUTO EMPLOYEES/
0720;S62,GENERAL MERCHANDISE EMPLOYEES/
0730;S63,GENERAL MERCHANDISE RETAIL STORES/
0740;S64,LABOR FORCE/
0750;S65,TOTAL BANK ASSETS/
0760;S66,WHOLESALE GROCERIES/
0770;S67,WHOLESALE GROCERY EMPLOYEES/
0780;S68,TRUCKING & WAREHOUSING COMPANIES/
0790;S69,NO EMPLOYEES TRUCKING & WAREHOUSING/
0800;S70,EMPLOYEE,URBAN PASSENGER TRANSPORT/
0810;S71,SAVINGS & LOAN TOTAL ASSETS/
0820;S72,MOTOR VEHICLE REGISTRATIONS/
0830;S73,TELEPHONE CONNECTIONS/
0840;S74,ELECTRICAL CONNECTIONS/
0850;S75,GAS CONNECTIONS/
0860;S76,WATER CONNECTIONS/
0870;S77,STUDENTS,LAREDO JUNIOR COLLEGE/
0880;S78,GED STUDENTS,LAREDO JUNIOR COLLEGE/
0890;S79,TOTAL POLICE HOURS EXPENDED/
0900;S80,TOTAL POLICE ASSIGNED/
0910;S81,PERCENT MANNED, POLICE FORCE/
0920;S82,TOTAL TRAFFIC ACCIDENTS/
0930;S83,TOTAL GUILTY TRAFFIC VIOLATIONS/
```

```
0940;S84,TOTAL ARRESTS,CRIMINAL, LAREDO PD/
0950;S85,EXPORTS/
0960;S86,IMPORTS/
0970LIST CASES;CASES=11/
0980RAW OUTPUT UNIT15
0990FACTOR;VARIABLES=ALL/
1000;TYPE=PAI/
1010;ROTATE=VARIMAX/
1020;NFACTORS=8/
1030;FACSCORE/
1040OPTIONS;5,6,11
1050STATISTICS;1,4,5,6,8
1060READ INPUT DATA
1070$:SELECTA:77A72/LARDON
1080FINISH
1090$END JOB
```

APPENDIX H

FACTOR SCORES

Factor Scores

Yr	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
65	-1.621590	0.309320	0.073280	0.495664	0.071707	-0.356271	-0.285405	0.227181
66	-1.467521	0.260681	0.284684	0.345478	0.240377	-0.136333	-0.289203	-0.228644
67	-1.287214	0.093026	0.396237	0.246828	-0.073569	0.289979	0.174352	-0.077681
68	-0.228880	-0.340164	-0.839817	-2.038401	0.170119	1.265998	0.553081	1.434326
69	0.165001	-0.418739	-1.067989	-0.981113	-0.153198	-0.124712	-0.038324	-2.584635
70	0.488178	-0.540103	-1.222622	1.285212	-2.200167	-0.092604	0.386179	0.596941
71	0.775528	-1.051951	-0.553121	0.386846	1.169284	-0.438589	-2.201246	0.625747
72	0.603539	-0.908383	0.235817	0.637868	1.456997	-0.947746	2.095348	0.129818
73	0.725344	-0.967998	2.408335	-0.274963	-0.857086	0.810402	-0.289481	-0.292069
74	0.776634	1.672591	0.469391	-1.092653	-0.544075	-1.918276	-0.159174	0.464052
75	1.070979	1.891720	-0.184195	0.989234	0.719611	1.648152	0.053871	-0.295035

APPENDIX I

ORIGINAL DATA

Environmental Indicators

Year	Environmental Indicator Number and Title				
	S01 No. of Bldg Permits Issued	S02 $ Value of Bldg Permits Issued	S03 Total Bank Deposits	S04 Taxes Assessed Valuation	S05 Tax Rate
1965	369[a]	2296176[a]	81310000[a]	57927185	2.15
1966	382[a]	2700564[a]	81956000[a]	59586821	2.15
1967	409	3887449	83248000[a]	61888812	2.15
1968	396	3509341	85832821	85889545	1.95
1969	424	4213956	91000351	86706975	1.85
1970	496	6414042	101443742	89707735	1.75
1971	577	8184650	123937950	93297555	1.75
1972	613	21983321	158593812	98162220	1.75
1973	611	14903729	215504937	103798160	1.75
1974	414	8424851	257375226	109013975	1.75
1975	581	13034578	305033277	112353115	1.75

Year	Environmental Indicator Number and Title (continued)				
	S06 Civic Center & Swimming Pool Exp.	S07 Fire Protection Employees	S08 Gen. Government Exp.	S09 Health & Hospital Exp.	S10 Local Media
1965	27811	92[a]	424334	116872	7
1966	55368	92[a]	454000	120250	8
1967	63637	86	561371	129295	8
1968	57423	99	613252	135875	8
1969	69389	87	678622	153583	7
1970	78438	85	706746	172801	8
1971	93273	93	793045	200299	10
1972	87567	76	887129	216800	10
1973	107727	98	856701	218509	14
1974	101419	98	1161468	267971	13
1975	105918	94	1447180	279169	13

Year	Environmental Indicator Number and Title (continued)				
	S11 Miles of Storm Sewers	S12 Miles of Sanitary Sewers	S13 Miles of Graded Streets	S14 Miles of Paved Streets	S15 Full Time Municipal Emp.
1965	16.0	81[b]	165[a]	68[a]	453[a]
1966	16.0	82[b]	167[a]	68[a]	465[a]
1967	16.0	83[b]	170	69	477
1968	16.5	85[b]	185	75	472
1969	16.5	85[b]	190	83	474
1970	16.5	85[b]	195	90	520
1971	16.5	85	195	85	628
1972	16.5	93	198	91	558
1973	16.5	96	202	95	559
1974	20.0	98	206	104	555
1975	24.0	100	216	107	604

Year	Environmental Indicator Number and Title (continued)				
	S16 No. of Part Time Emp.	S17 No. of Registered Voters	S18 % Voting in Pres. Elect.	S19 Public Safety Exp.	S20 Public Welfare Exp.
1965	55[a]	13825[c]	65.7[c]	694771	63588
1966	59[a]	15550[c]	64.0[c]	704389	63506
1967	63	17275[c]	62.3[c]	783399	69241
1968	94	19000	60.6	816832	71683
1969	53	20725[c]	58.3[c]	1054665	93849
1970	47	22450[c]	55.9[c]	1355327	137842
1971	106	24175[c]	53.6[c]	1340308	112449
1972	82	25900	51.2	1524214	170625
1973	82	28550[c]	48.4[c]	1545498	172147
1974	127	31200[c]	45.6[c]	1981246	172686
1975	146	33850[c]	42.7[c]	2107201	200755

Year	Environmental Indicator Number and Title (continued)				
	S21 Dollars of Retail Sales	S22 Sanitation Exp.	S23 No. of Street Lights	S24 Unemployment Rate	S25 Dept of Agriculture Outlays
1965	76365000[a]	595620	1818[a]	9.455[a]	1033138[a]
1966	84521000[a]	638583	1881[a]	9.312[a]	1131055[a]
1967	92677000[a]	762934	1945	9.170[a]	1228972[a]
1968	100833000	844924	2161	9.025	1326889
1969	108989000	1190720	2428	7.556	1862738
1970	153842000	1117134	2490	10.325	1552594
1971	148101277	1297598	2557	11.100	2888896
1972	161714335	1571770	2409	11.300	3067018
1973	197133700	1556511	2437	11.558	3084730
1974	238744000	2597319	2466	14.780	6760000
1975	246697880	2319082	2466	19.080	11862000

Year	Environmental Indicator Number and Title (continued)				
	S26 Dept of Commerce Outlays	S27 DOD Civilian Pay	S28 DOD Military Active Duty Pay	S29 DOD Reserve & Natl Guard Pay	S30 DOD Military Retired Pay
1965	59700[a]	4050000[a]	6549000[a]	116000[a]	305000[a]
1966	59700[a]	4209000[a]	9659000[a]	150000[a]	314000[a]
1967	59700[a]	4368000[a]	12769000[a]	184000[a]	323000[a]
1968	59729	4527000	15879000	218000	332000
1969	57047	4686000	18989000	252000	314000
1970	259580	5308000	22681000	384000	490000
1971	38024	5737000	24661000	367000	538000
1972	106712	6163000	28140000	306000	676000
1973	175400	5740000	25509000	354000	809000
1974	57000	2290000	1736000	348000	874000
1975	1373000	1156000	918000	457000	1051000

Year	Environmental Indicator Number and Title (continued)				
	S31 DOD Prime Supply Contracts Value	S32 DOD Prime Svc Contracts Value	S33 DOD Prime Const. Contracts Value	S34 DOD Contracts Less Than $10,000	S35 HEW Outlays
1965	850000[a]	1906000[a]	8900000[a]	2360000[a]	1961200[a]
1966	850000[a]	1937000[a]	8400000[a]	2366000[a]	4531380[a]
1967	850000[a]	1968000[a]	7900000[a]	2366000[a]	7101560[a]
1968	2053000	1999000	7394000	2217000	9671742
1969	1508000	2062000	1011000	2468000	12522633
1970	22000	2122000	70000	2421000	14529321
1971	667000	2485000	703000	3079000	17381983
1972	398000	1959000	818000	3596000	22215616
1973	697000	1892000	119000	3440000	23492420
1974	1445000	718000	0	207000	30200000
1975	14000	284000	0	0	44953000

Year	Environmental Indicator Number and Title (continued)				
	S36 HUD Outlays	S37 Dept. of Labor Outlays	S38 No. of Students Registered	S39 Student Teacher Ratio	S40 Water Quality, Coliform Increase
1965	2074600[a]	614319[a]	15470[a]	25.56[a]	140830
1966	2074600[a]	785425[a]	15841[a]	25.71[a]	68520
1967	2074600[a]	956532[a]	16212	25.86	111520
1968	2505200	1127638	17468	26.27	83054
1969	1309000	1917350	18179	27.42	143760
1970	1574281	2033470	18834	26.87	293850
1971	2910000	2209683	18845	25.23	293420
1972	11724000	3007795	19787	24.49	128815
1973	5647400	1906703	20129	23.08	332183
1974	1562000	1902000	20204	22.70	136940
1975	3090000	4624000	20757	23.19	144585

Year	Environmental Indicator Number and Title (continued)				
	S41 Water Quality, Bacteria Increase	S42 No. of Fire Hydrants	S43 Dept of Trans. Outlays	S44 Civil Service Exp.	S45 GSA Exp.
1965	61020	677[a]	200111[a]	552065[a]	420760[a]
1966	54500	698[a]	200111[a]	558158[a]	420760[a]
1967	61010	718	200111[a]	570344[a]	420760[a]
1968	61490	728	384855	619087	243235
1969	56180	750	224733	716573	795607
1970	98149	760	688138	835342	334126
1971	46420	899	112305	863103	333043
1972	31641	909	1438620	1040376	408040
1973	85659	950	694972	1271307	341027
1974	65035	960	1510000	1625000	403000
1975	43138	855	1626000	2080000	508000

Year	Environmental Indicator Number and Title (continued)				
	S46 Office of Economic Opportunity Exp.	S47 SBA Exp.	S48 Tot. Fed. Outlays Webb County	S49 Tot. Fed. Outlays Laredo	S50 Population Laredo
1965	1142000[a]	421900[a]	50000000[a]	38000000[a]	65000
1966	1142000[a]	384150[a]	53300000[a]	40000000[a]	67000
1967	1142000[a]	346400[a]	56600000[a]	45000000[a]	67500
1968	1865092	308650	60325347	47908943	68000
1969	970550	270900	60140147	51232647	70000
1970	1073276	459600	63688347	54884499	72000
1971	1246366	810950	72480741	32730483	72000
1972	991015	1489365	86363072	39933545	72000
1973	1233410	2288187	86234518	42000434	75000
1974	615000	1341000	67399000	45309000	75000
1975	0	1201000	93621000	60549000	75000

Year	Environmental Indicator Number and Title (continued)				
	S51 Tot. Hsng Const. Permits Issued	S52 Single-Unit Housing Const. Permits Issued	S53 5 or More-Units Housing Const. Permits Issued	S54 Drug Arrests	S55 Total Volumns in City Library
1965	166[a]	150[a]	0	130[a]	22310
1966	167	154	10	134[a]	23723
1967	166	146	20	138[a]	24961
1968	169	161	0	142[a]	25961
1969	157	154	0	146[a]	27008
1970	404	241	160	150	27844
1971	537	242	295	154	28745
1972	550	241	307	122	29909
1973	628	139	485	125	31347
1974	97	97	0	376	32467
1975	363	360	0	407	34409

Year	Environmental Indicator Number and Title (continued)				
	S56 No. of Doctors' Offices	S57 No. of Doctors' Employees	S58 No. of Taverns & Restaurants	S59 No. of Taverns & Restaurant Emp.	S60 Auto Dealers & Svc Stations
1965	24	67	78	482	68
1966	23	74	83	512	71
1967	23	90	76	504	76
1968	25	96	65	534	72
1969	27	94	77	507	79
1970	27	94	66	457	78
1971	29	109	65	410	76
1972	29	162	69	435	72
1973	30	181	69	529	77
1974	32	200	87	686	109
1975	33	215	103	636	118

Year	Environmental Indicator Number and Title (continued)				
	S61 No. of Auto Dealers & Svc Stn Emp	S62 No. of Gen. Merchandise Employees	S63 No. of Gen. Merchandise Retail Stores	S64 Labor Force	S65 Total Bank Assets
1965	623	782	27	26185[a]	60390000[a]
1966	642	824	25	27345[a]	71400000
1967	634	895	28	28505[a]	82420000[a]
1968	569	814	32	29665	93430000
1969	605	930	23	30825	102303866
1970	652	1128	23	31390	114904132
1971	582	1025	26	31410	138390071
1972	636	1176	27	30330	174466569
1973	634	1227	23	23195	234876620
1974	683	1547	21	20315	279167167
1975	701	1622	22	25110	333900813

Year	Environmental Indicator Number and Title (continued)				
	S66 No. of Wholesale Grocery Co	S67 No. of Wholesale Grocery Emp	S68 No. of Trucking & Warehousing Co.	S69 No. of Trucking & Warehousing Emp.	S70 No. of Urban Passenger Transportation
1965	30	272	30	332	114
1966	29	285	32	385	118
1967	25	246	31	378	127
1968	32	313	31	353	119
1969	30	377	29	367	104
1970	28	351	30	418	101
1971	28	391	35	383	108
1972	28	379	35	450	107
1973	22	265	37	603	114
1974	24	325	33	494	105
1975	25	340	34	517	105

Year	Environmental Indicator Number and Title (continued)				
	S71 Savings & Loan Total Assets	S72 Motor Vehicle Registration	S73 Telephone Connections	S74 Electrical Connections	S75 Gas Connections
1965	4000000[a]	22096[a]	14818[a]	16260[a]	14823[a]
1966	6000000[a]	25564[a]	17212[a]	16814[a]	14899[a]
1967	8000000[a]	29032[a]	19606[a]	17368[a]	14975[a]
1968	10000000[a]	32500	22000	17922	15051
1969	12000000[a]	35968	25520	18476	15127
1970	14000000[a]	40077	27914	19112	15521
1971	16358633	43566	29650	19927	15776
1972	18753015	34153	31808	20616	16079
1973	20901771	52224	30674	20747	15970
1974	24360336	40627	33881	21607	16678
1975	31227382	48118	37007	22719	17385

Year	Environmental Indicator Number and Title (continued)				
	S76 Water Connections	S77 Students at Laredo Junior College	S78 GED Students at Laredo Jr College	S79 Total Police Hours Expended	S80 Total Police Assigned
1965	13103[a]	686[d]	26[d]	97219[a]	81[a]
1966	13454[a]	689[d]	27[d]	97219[a]	81[a]
1967	13805[a]	689[d]	28[d]	97219[a]	81[a]
1968	14156	695[d]	30[d]	97219[a]	81[a]
1969	14507	707[d]	36[d]	97219	81[a]
1970	15003	736[d]	48[d]	101993	81
1971	15460	782	72	146165	80
1972	16009	833	96	150943	74
1973	16200	1562	108	116583	72
1974	16583	1166	90	125447	73
1975	17289	1530	198	156738	85

Year	Environmental Indicator Number and Title (continued)					
	S81 % Manned Laredo Police Force	S82 Total Traffic Accidents	S83 Total Guilty of Traffic Violations	S84 Total Arrests For Criminal Activity	S85 Dollars of Exports	S86 Dollars of Imports
1965	98.8[a]	1552[a]	3000[a]	610[a]	725228000[a]	188367000[a]
1966	98.8[a]	1559[a]	3000[a]	674[a]	775556000[a]	207439000[a]
1967	98.8[a]	1566	3000[a]	821[a]	825883000[a]	226511000[a]
1968	98.8[a]	1589	3514	1116	876211000[a]	245583000[a]
1969	98.8[a]	1589	2457	1411	915695000[a]	298908000[a]
1970	98.8	1782	2909	1757	955180000[a]	352233000[a]
1971	95.2	1726	2501	2269	994664103	405558012
1972	88.1	1803	1986	2311	1109801198	548867784
1973	85.7	2155	3071	2501	1575634755	753113651
1974	86.9	2670	2118	2459	2558772777	1033334121
1975	100.0	2851	3665	1571	2900000000	1233354000

Environmental Indicator Number and Title (continued)

a. Estimated for purposes of factor analysis.

b. Adjusted Miles of Sanitary Sewers to account for adjustment in city records from 1970 to 1971.

c. Interpolated values based upon Registered Voters and % Voting in Presidential Elections in 1964, 1968, 1972, and 1976 for purposes of factor analysis.

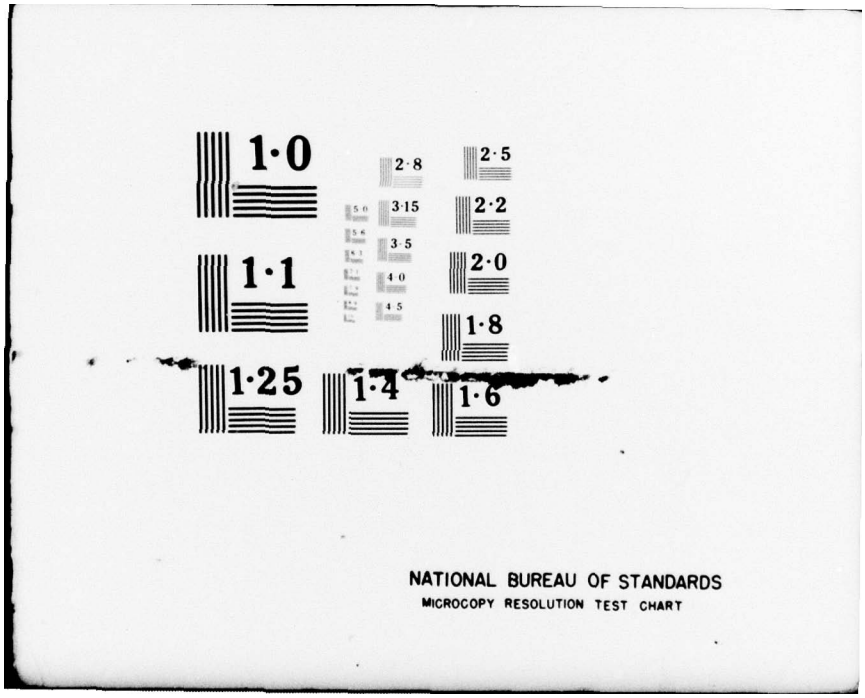
d. Estimated for purposes of factor analysis, Laredo Junior College began in 1971.

AD-A044 079 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCHO--ETC F/G 1/5
THE ENVIRONMENTAL IMPACT OF BASE CLOSURE: A CASE STUDY OF LARED--ETC(U)
JUN 77 R O CARDINALE, R E KOHN

UNCLASSIFIED AFIT-LSSR-8-77A NL

3 OF 3
ADA
044079

END
DATE
FILMED
10-77
DDC


1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5
2·8
3·15
3·5
4·0
4·5
5·0
5·6
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

BIBLIOGRAPHY

A. REFERENCES CITED

1. Adams, Major General Milton R., USAF (Retired). President of the Laredo Chamber of Commerce, Laredo, TX. Personal interview. 29 December 1976.

2. Anderson, Commander Forrest P., USN. Defense Cutbacks Some Effects and Solutions. Washington: Industrial College of the Armed Forces, 1971.

3. Barker, Captain Daniel J., USAF, and Captain Don H. Ray, USAF. "Physical Impacts of Base Closures (Bellefontaine)." Unpublished thesis. SLSR 10-76A, AFIT/SL, Wright-Patterson AFB OH 1976.

4. Barr, Captain Thomas F., USAF, and Captain Anthony C. Nardecchia, Jr., USAF. "The Economic Impact of a Military Installation Closure on a Nearby Community: A Case Study of Available Data." Unpublished master's thesis. SLSR 8-76A, AFIT/SL, Wright-Patterson AFB OH 1976.

5. Battelle Columbus Laboratories, Socio-Economic Background and Potential Impacts Related to the Proposed Relocation of Headquarters Air Force Communications Service to Scott Air Force Base, Il. Background Study Number 7, Columbus OH, 9 April 1976.

6. Brown, Robert Goodell. Smoothing, Forecasting and Prediction. Englewood Cliffs, NJ: Arthur D. Little, Incorporated, 1963.

7. Buckley, Nora C. "An Overview of Studies of the Impact of Military Installations and Their Closings on Nearby Communities." Unpublished research report Serial T-338. George Washington University, 1976.

8. Callen, Paul C. "Economic Impact of Fort Detrick on Frederick, Maryland." Unpublished master's thesis, University of Maryland and Institute for Defense Analysis, Washington, D.C., 1967.

9. Clark, Charles T., and Lawrence L. Schkade. Statistical Analysis for Administrative Decisions. Cincinatti: South Western Publishing Company, 1974.

10. Congressional and Administrative News, January 20, 1970, No. 13, St Paul: West Publishing Co.

11. Crawford, George L., and Associates, Inc., Background Study 15 Analysis of Transportation Richards-Gebaur AFB/Scott AFB. Maryland Heights, MO, 15 April 1976.

12. Daicoff, Darwin W., and others. "Economic Impact of Military Base Closings, Vol. II." Unpublished research report, ACDA/E-90, United States Arms Control and Disarmament Agency, Lawrence, KA, 1970.

13. Emory, C. William. Business Research Methods. Homewood, IL: Richard D. Irwin, Incorporated, 1976.

14. Environmental Protection Agency. The Quality of Life Concept. Washington: U.S. Government Printing Office, 1973.

15. Frey, Captain William J., USAF. "The Social Impact on a Community Resulting from a Military Base Mission Change." Unpublished master's thesis. SLSR 6-76B AFIT/SL, Wright-Patterson AFB OH 1976.

16. Harmon, Harry H. Modern Factor Analysis. Chicago: The University of Chicago Press, 1960.

17. Harris, Frederick R. Associates, Economic Impact Study of the Deactivation of Lincoln Air Force Base. New York, September 1965.

18. Harris, Major Larry W., USAF, and Captain Kenneth B. Beckham, USAF. "An Air Force Base Closure: The Physical and Natural Environmental Impact Unpublished master's thesis. SLSR 20-76A AFIT/SL, Wright-Patterson AFB OH 1976.

19. Henriot, Peter J. "Political Aspects of Social Indicators: Implications for Research," Social Science Frontiers. New York: Russell Sage Foundation, 1972.

20. Hershow, Sheila. "Ford Blocks Delays on Base Closings," Federal Times, 19 July 1976, p. 1.

21. Honeywell Corporation. Series 6000/600/400/G-200 Time Series Forecasting Implementation Guide. Order No. BQ08. Minneapolis: Honeywell Information Systems Incorporated, 1973.

22. Jain, R. K., and others. "Environmental Impact Assessment Study for Army Military Programs." Unpublished research report No. CERL-IR-D-13, Army Construction Engineering Research Laboratory, Champaign, IL, 1973.

23. _____, L. V. Urban, and A. J. Cerchione. "Handbook for Environmental Impact Analysis." Technical Report N-1, Construction Engineering Research Laboratory, Champaign, IL, 1976.

24. Kelley, George J., Jr. "The Economics of National Defense-The Impact of the Base Structure." Unpublished Ph.D. dissertation, George Washington University, Washington, June 1964.

25. Laben, Lawrence E. "The Economic Impact of a Military Base." Unpublished master's thesis, Massachusetts Institute of Technology, Cambridge, MA, 1961.

26. Lewis, Charlie. Staff Civil Engineer, Civil Engineering Center, Tyndall AFB, FL. Personal interview. September 27, 1976.

27. Liu, Ben-Chieh. "Quality of Life Indicators in U.S. Metropolitan Areas, 1970." Unpublished research report, Grant No. R803049-01-0, Washington Environmental Research Center. U.S. Environmental Protection Agency, May 1975.

28. Lynch, John E. "Local Economic Recovery from Military Base Closures." Unpublished report, unnumbered, Department of the Air Force, Washington, April 1969.

29. Martinez, Blas. Community Development Council, Laredo, TX. Personal interview. 30 December 1976.

30. McDowell, Captain Lance, USAF, and Captain David A. Weber, USAF. "The Social Impact on a Community Resulting from a Military Base Closure (Bellefontaine, Ohio)." Unpublished master's thesis. SLSR 9-76A AFIT/SL, Wright-Patterson AFB OH 1976.

31. McGarvey, Maj Gen Billie J. "Air Force Environmental Planning," Supplement to the Air Force Policy Letter for Commanders, No. 5-1975 (May, 1975), pp. 27-31.

32. "Meaning of Latest U.S. Base Closings," U.S. News and World Report, December 2, 1974, p. 40.

33. Naval School, Civil Engineer Corps Officers. Curriculum for Environmental Protection Course. Port Hueneme CA, June 1974.

34. Nie, Norman H., and others. Statistical Package for the Social Sciences. New York: McGraw-Hill Inc., 1965.

35. Office of Assistant Secretary of Defense (Public Affairs). News Release. Washington, March 11, 1976.

36. _____. News Release. Washington, March 17, 1976.

37. _____. News Release. Washington, April 1, 1976.

38. "Official Indicators: What Are They? Can They Predict the Future?," U.S. News and World Report, August 16, 1976, pp. 66-67.

39. Parsons, Captain Robert J., USAF. "The Economic Impact of a Military Installation Closure on the Surrounding Community: Clinton County Air Force Base." Unpublished master's theses. SLSR 5-76B AFIT/SL, Wright-Patterson AFB OH 1976.

40. Peck, Colonel Gaillard R., USAF (Retired). Airport Manager, Laredo, TX. Personal interview. 28 December 1976.

41. President's Economic Adjustment Committee, Communities Affected by the Defense Facility and Activity Realignments Announced on April 17, 1973. Background Study Number 18, Washington, July 1973.

42. _____. Economic Recovery. Washington: Defense Office of Economic Adjustment, 1975.

43. Stein, Jess, ed. The Random House Dictionary of the English Language. New York: Random House, 1966.

44. Sweeney, Lt Col Patrick J., USAF. Instructor of Facilities Management, Department of Functional Management, Graduate Education Division, School of Systems and Logistics, Air Force Institute

of Technology (AU), Wright-Patterson AFB, OH. Personal interviews. Conducted intermittently from August 1976 through May 1977.

45. Team Four Inc., Analysis of Land Use and Governmental Structure Richards-Gebaur AFB/Scott AFB. Background Studies 10/11, St. Louis, 15 April 1976.

46. Terner, Donald I. "The Economic Impact of a Military Installation on the Surrounding Area." Unpublished report No. 30, Federal Reserve Bank of Boston, Boston, 1965.

47. Texas Commerce Bancshares, Incorporated. Texas Facts and Figures. 8th ed. Houston: Texas Commerce Bancshares, Incorporated, 1976.

48. The United States District Court for the Western District of Missouri, Western Division. Robert L. McDowell, et al versus James R. Schlesinger, et al. Court Order No. 75-CV-234-W-4. July 19, 1975.

49. Thompson, Major General Robert C., USAF. Director of Civil Engineering, HQ USAF. Letter, subject: Environmental Planning Function and Process-Policy, to ALMAJCOM/DE, 8 July 1975.

50. U.S. Department of the Air Force. "Environmental Narrative-Phase 1 TAB A-1." HQ USAF/PREV, Pentagon, Washington, D.C., April, 1975.

51. _____. Environmental Protection: Environmental Assessments and Statements. AFR 19-2, 20 January 1972. Washington: Government Printing Office, 1972.

52. U.S. Department of the Army. Environmental Protection and Enhancement. AR 200-1, 14 November 1975. Washington: Government Printing Office.

53. U.S. Environmental Protection Agency. Action for Environmental Quality: Washington: Government Printing Office, March 1973.

54. Watkins, George A. "Social Impact Assessment and Public Participation." Unpublished seminar, Battelle-Columbus Laboratory, October, 1975.

55. "Who Gets Hurt When Military Bases Shut Down," U.S. News and World Report, June 3, 1974, pp. 68-70.

B. RELATED SOURCES

Air Force Civil Engineering Center, Relocation of Air Force Communications Service to Scott AFB Illinois. Background Study Number 16, Tyndall AFB FL, 20 April 1976.

Balbach, H. E. and others. "Environmental Impact Assessment Study for Army Military Programs." Unpublished report No. CERL-IR-13, U.S. Army Construction Engineering Research Laboratory, December, 1973.

Daicoff, Darwin W., and others. "Economic Impact of Military Base Closings, Vol. I." Unpublished research report ACDA/E-90, United States Arms Control and Disarmament Agency, Lawrence, KA, 1970.

"Defense Cutbacks: How Risky?," U.S. News and World Report, December 22, 1975, pp. 20-21.

Department of the Army. Construction Engineering Research Laboratory. "Environmental Impact Computer-System Attribute Descriptor Package-Socio-Economic Factors." Department of the Army, Washington, D.C., June 1975, pp. 548-562.

Environmental Reporter, Bureau of National Affairs, Inc., December 12, 1975, Vol. 6, No. 47.

_____, Bureau of National Affairs, Inc., March 19, 1976, Vol. 6, No. 47.

Jain, R. K., and others. "Development of the Environmental Technical Information System." Interim Report E-52, Army Construction Engineering Research Laboratory, Champaign, IL, April, 1975.

_____, L. V. Urban, and G. S. Stacey. "Handbook for Environmental Analysis." Technical report E-59, Construction Engineering Research Laboratory, Champaign, IL, September, 1974.

"Losing a Military Base Isn't All That Bad," Business Week, July 27, 1974, pp. 77-78.

Mackin, James L., and Richard A. Schmidt. "Support of Environmental Planning." Unpublished research project No. 1878, Stanford Research Institute, Menlo Park, CA, 1972.

McAuliffe, R. A., The Salina Story, Swords Into Plowshares, Washington: Office of Economic Adjustment, Office of the Secretary of Defense, August, 1965.

Office of County Counselor, Comments of Jackson County, Missouri on Richards-Gebaur Air Force Base Proposed Realignment of Air Force Communications Service. Background Study Number 22, Kansas City, 23 January 1976.

Ortolano, Leonard, and William W. Hill. "An Analysis of Environmental Statements for Corps of Engineers' Water Projects." Unpublished report 72-3, Institute for Water Resources, Virginia, 1972.

_____. "Analyzing the Environmental Impacts of Water Projects." Unpublished report, 73-3, Institute for Water Resources, Virginia, 1972.

Rossi, Peter A. "Community Social Indicators," in The Human Meaning of Social Change. New York: Russell Sage Foundation, 1972.

Solomon, Major Howard N. "Air Base Closure to Economic Recovery, the Communities' Dilemma." Unpublished thesis, Air Command and Staff College (AU), Maxwell AFB, AL, 1967.

Stanford Research Institute, Support of Environmental Program Planning. Defense Advanced Research Projects Agency Order Number 2195, Menlo Park, October 1972.

"The Bureaucracy Explosion," U.S. News and World Report, August 16, 1976, pp. 22-26.

Tiebout, Charles M. "The Regional Impact of Defense Expenditures: Its Measurement and Problems of Adjustment," Defense and Disarmament, ed. Roger E. Bolton. New Jersey: Prentice-Hall, 1966, pp. 65-124.

Urban, L. V., and others. Computer-Aided Environmental Impact Analysis for Construction Activities: User Manual. Technical Report E-50. Army Construction Engineering Research Laboratory, Champaign, IL, March, 1975.

U.S. Arms Control and Disarmament Agency. Economic Impact of Military Base Closings. Unpublished report ACDA/E-90, University of Kansas, 1970.

U.S. Congress. National Environmental Policy Act of 1969. Public Law 91-190. Washington: Government Printing Office, 1970.

U.S. Department of the Air Force. Assessment, Evaluation, Enhancement, and Protection of Environmental Quality. HQOI 19-1. Washington: Government Printing Office, 11 May 1971.

_____. Environmental Protection: Protection and Enhancement of Environmental Quality. AFR 19-1, 18 February, 1972. Washington: Government Printing Office, 1972.

U.S. Department of the Army. Handbook of Environmental Impact Analysis. Construction Engineering Research Laboratory, IL, 1974.

Watkins, George A. "Social Impact Assessment and Public Participation." Unpublished report, unnumbered, Battelle-Columbus Laboratory, June, 1975.

Weiss, Steven T., and Edward C. Gooding. "Estimation of Differential Employment Multipliers in a Small Regional Economy." Unpublished research report, No. 37, Federal Reserve Bank of Boston, Boston, 1966.

BIOGRAPHICAL SKETCHES

BIOGRAPHICAL SKETCHES

Captain Cardinale graduated from Newark College of Engineering in June, 1969, with a Bachelor of Science degree in Mechanical Engineering. He received his commission through the Reserve Officer Training Program and entered active duty in September, 1969. His initial assignment was to the 6940th Support Group (USAFSS), Goodfellow AFB, Texas, as a Civil Engineering Officer followed by tours to the 6986th Security Group (USAFSS), Wakkanai AS, Japan; 6921st Security Wing (USAFSS), Misawa AB, Japan; 6171st Combat Support Squadron, Kwang Ju AB, Korea; 2750th Civil Engineering Squadron, Wright-Patterson AFB, Ohio, and in May, 1975 arrived at AFIT School of Systems and Logistics. Captain Cardinale's next duty assignment will be within the Engineering and Services Directorate, Headquarters Tactical Air Command, Langley AFB, Virginia.

Captain Kohn graduated from Oklahoma State University in January, 1971, with a Bachelor of Science degree in Civil Engineering. He received his commission through the Officer Training School Program and entered active duty in April, 1971. His initial assignment was to the 4787th Air Base Group, Duluth International Airport, Minnesota, as a Civil Engineering Officer, followed by tours to the 23rd Air Division, Duluth International Air-

port, Minnesota; 719th Aircraft Control and Warning Squadron, Sparrevohn Air Force Station, Alaska; 2750th Civil Engineering Squadron, Wright-Patterson AFB, Ohio, and in May, 1975 arrived at AFIT School of Systems and Logistics. Captain Kohn's next duty assignment will be within the Engineering and Services Directorate, Headquarters Pacific Air Forces, Hickam AFB, Hawaii.