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Air Force Region of Influence Model (AFROI): User Manual

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The Air Force Region of Influence Model (AFROI) is an interactive computer system for identifying geographic areas that would receive significant economic impacts following a realignment action. AFROI utilizes a modified economic base model which incorporates a gravity potential submodel to determine the spatial distribution of direct expenditures generated by an AF activity. County-level income and employment impacts are calculated by AFROI and compared to forecasts of future economic activity in the region, assuming no change in status of the AF installation, to evaluate the significance of impacts.

This manual provides information on how to use AFROI. It describes how to enter the system, gather data, and run the model. This discussion is made clearer through the use of several example problems. Finally, the AFROI econometric model is described both in general terms and in a technical appendix in order to provide the user with the understanding needed to interpret model results. AFROI is maintained by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) as part of the Environmental Technical Information System (ETIS).

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needed to interpret model results. AFROI is maintained by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) as part of the Environmental Technical Information System (ETIS).

FOREWORD

This research was conducted for the Air Force Engineering and Services Center (AFESC), Tyndal AFB, FL under project identification number CERL-EN 84-042. Mr. Allen Nixon, AFESC, was the technical monitor. Ms. Linda Merritt, AFESC, was the Air Force POC.

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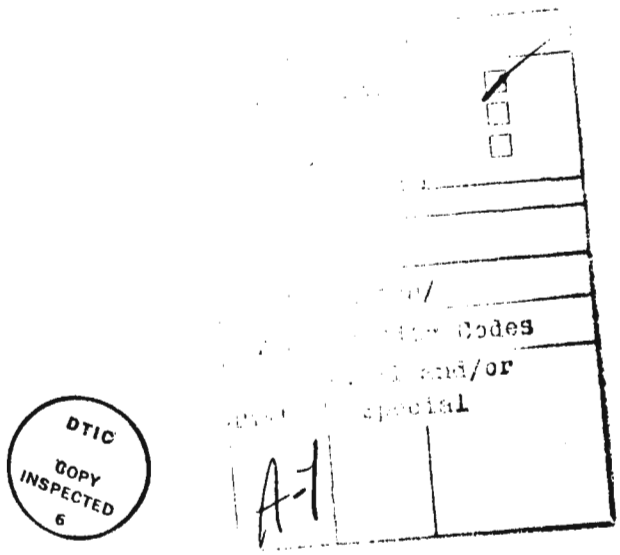

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1. INTRODUCTION

1.1 How to Use Manual

This manual provides information on how to use the Air Force Region of Influence (AFROI) model. The model describes the magnitude of economic effects of Air Force (AF) activities by geographic area (i.e., county units). AFROI is maintained in an interactive computer system called the Environmental Technical Information System (ETIS) (Webster et al, 1975) which was developed and is maintained by the University of Illinois, Champaign, IL.

Once the user has accessed ETIS (refer to Section 1.5), he* can use this manual to operate AFROI. The first time user should review all sections of the manual. The contents are as follows:

- Section 1.0 presents a brief background and overview of the system
- Section 2.0 describes the econometric model that is the basis of AFROI and is intended to give the user the understanding needed to interpret results
- Section 3.0 describes the types of tasks that can be performed by AFROI
- Section 4.0 contains information on how to enter the system, gather data, and run the model
- Section 5.0 contains example problems.

After modest experience with AFROI, this manual should be needed only for reference.

1.2 Background

Since the advent of the National Environmental Policy Act (NEPA) and other governmental regulations and policies, the Department of Defense (DoD) has sought to develop systems that foster rapid, systematic, and uniform analysis of the effects of military activities. In 1978 the AF initiated development of techniques for assessing the socioeconomic aspects of its operations (Pierce, February 1978 and September 1978). Over time these have been updated and refined to meet changing and more demanding requirements (Webster et. al., 1982; Gunther, 1981 and 1982; Pierce, 1983; Bloomquist, 1986).

A primary concern in socioeconomic analyses is the identification of the geographic extent of significant change resulting from an action or

*The male pronoun is used to refer to both sexes.

ongoing operation. The AF has adopted the concept of region of influence (ROI) to describe the area affected by the operation of AF installations.

Historically, ROIs have been defined as the area where 90 percent of AF personnel reside and most AF personnel and base spending occurs. Once defined the ROI becomes the basis for subsequent socioeconomic analysis.

1.3 Purpose of AFROI

The ROI concept has been successful and widely used for a variety of purposes, for example, environmental impact statements (EIS), local economic consequences studies (LECS) (Webster, et. al., 1982), and the Economic Resource Impact Statement (ERIS) (Department of the Air Force) which is prepared annually at each AF base. Consequently, the approach for defining ROIs has been refined, and AFROI has been made available through ETIS.

This manual presents the refined approach which has the following improvements:

- It has a theoretical basis for the selection of counties to be included in the ROI
- It provides a more accurate depiction of the effects of non-personal spending
- It considers change in counties outside the ROI
- It estimates the spatial distribution of change in counties near the activity
- It considers the structural differences in the economies of each county and does not treat the ROI as a homogeneous unit.

The manual also introduces the new concept: area of influence (AOI). An ROI is the area affected by the status quo operation of an AF installation and an AOI is the area affected by a specific activity such as a major construction project, deployment of a new weapon system, or personnel realignment. Except for new or increased activity, an AOI will be a subset of the ROI.

1.4 Overview of the Model

When a socioeconomic study is initiated, the analyst must select a geographic area of interest for which he will collect data and conduct subsequent analyses. Usually this selection is based on judgment and experience and therefore is subject to the skills of the analyst and questions of consistency.

AFROI eliminates potential errors and confusion by using an economic impact model to identify the counties of interest. AFROI calculates the change in sales volume, employment, and income for a particular activity using a modest amount of field data augmented by the data base housed in ETIS. Change is considered significant in a county where it exceeds a prescribed threshold. Such a county is recommended for inclusion in the ROI or AOI. The ROI or AOI counties, plus any others of potential interest, can then be analyzed in greater detail using other techniques (e.g., the impact models in ETIS such as LECS).

AFROI is a two stage model. In the first stage, the user selects a boundary region. It includes counties where direct and indirect expenditures of personnel, base contracting, and so forth are expected to occur. The model determines the direct AF expenditures in these counties and uses a gravity-potential model to simulate spending behavior and secondary transactions and distribute expenditures through the boundary region counties. From this, AFROI estimates the change in employment and income for each county using county specific data and multipliers.

In the second stage, the model evaluates the significance of the economic impacts. AFROI compares the change in employment and income to forecasted status quo conditions to determine whether the change falls outside the confidence interval of the forecast for each county. Where it does, the change is deemed significant.

1.5 Introduction to ETIS

To support the needs of DoD for environmental information and analysis, CERL developed the interactive ETIS. ETIS is an umbrella or "shell" program for several environmental "applications" programs including AFROI and Economic Impact Forecast System (EIFS). ETIS programs are controlled by the UNIX "operating system."*

ETIS is maintained on a Pyramid computer located in Champaign, Illinois, and can be accessed via a telephone (i.e., modem) hookup. The EIFS manual (Robinson et al., 1984) describes in detail the equipment and protocol required to access ETIS and EIFS. Once into ETIS, the procedures outlined in Section 4.1 should be used to access AFROI.

Once in the program, the user can use his terminal to type in and edit data and obtain AFROI results.

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* Several manuals describing the UNIX system are available; for example, Henry McGilton and Rachel Morgan, Introducing the UNIX System, McGraw Hill (1983).

2. TECHNICAL DESCRIPTION OF MODEL*

AFROI utilizes a modified economic base model which incorporates a gravity potential sub-model to determine the spatial distribution of direct expenditures generated by an AF activity. The primary steps carried out internally by the model are depicted in Figure 2.1, defined in Table 2.1 and summarized below.

(1) The user selects a boundary region that encompasses most of the direct and indirect impacts from an Air Force action. The boundary region may be defined as the BEA economic area surrounding the installation or alternatively, a maximum commuting distance.

(2) The model calculates the change in direct expenditures from four sources: employees' wages and salaries, procurements, construction expenditures, and other programs.

(3) A generalized gravity-potential model underlies the entire ROI definition process. First, a gravity model estimates the initial distribution of direct expenditures from an AF activity when actual data on the place of residence of employees and location of vendors or expenditure is not available. Second, the gravity model assesses how trading activity diffuses these direct expenditures to other counties in the boundary region. Finally, AFROI uses a variant of the basic gravity model to determine indirect employment and income impacts by place of residence.

(4) Both place of work and place of residence impacts are estimated for total employment and income for each county. These impacts are adjusted, as necessary, to reflect total impacts for the entire boundary region. The additional impacts, if any, are distributed among all counties in proportion to the impacts already estimated for each county.

(5) Finally, AFROI uses a statistical test to determine which counties qualify for inclusion in the ROI or AOI. The approach taken compares forecasted employment and income in each county, assuming no change in status of the installation, to the level of activity anticipated with the action. If the the change due the action falls outside a user-specified confidence interval, the county is included in the ROI or AOI.

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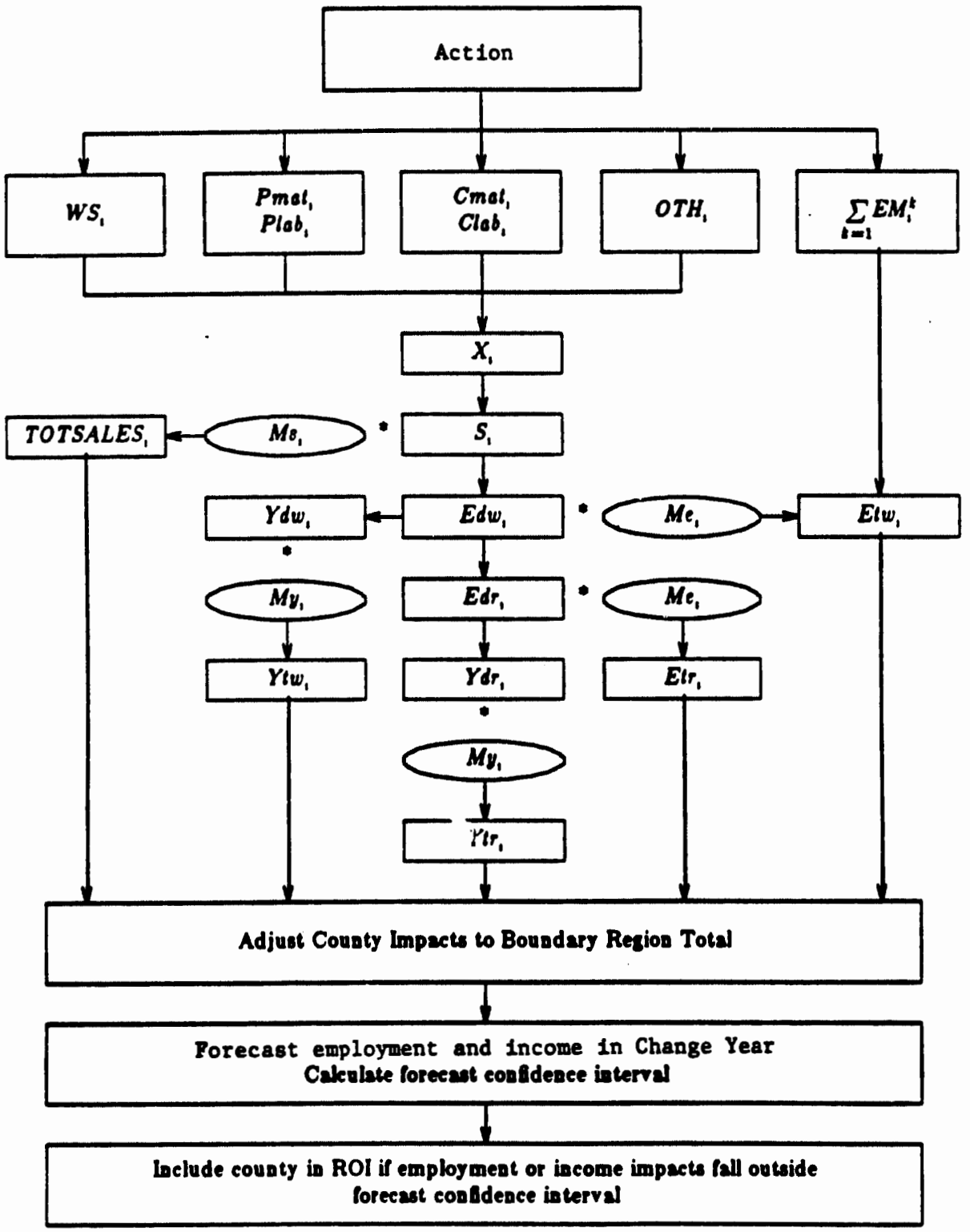
*This section was excerpted from Bloomquist (1986). A more complete description of the model appears in Appendix A.

Figure 2.1

A SIMPLIFIED VIEW OF THE AFROI MODEL



Key: * - Multiplication Operator; ⬭ - Export Base Multiplier.

Table 2.1

EXPLANATION OF SYMBOLS USED IN FIGURE 2.1

Symbol	Definition
WS_i	Direct wages and salaries paid to Air Force employees in county i.
$Pmat_i$	Direct expenditures for procurement materials in county i.
$Plab_i$	Direct expenditures for procurement labor in county i.
$Cmat_i$	Direct expenditures for construction materials in county i.
$Clab_i$	Direct expenditures for construction labor in county i.
OTH_i	Direct expenditures for other expenditures (e.g., CHAMPUS, education) in county i.
$\sum_{k=1} EM_i^k$	Total number of Air Force employees working in county i affected by a realignment action.
X_i	Direct change in expenditures from the realignment action.
S_i	Direct change in sales in county i from trading activity with all counties in boundary region ($\sum_{j=1} S_{ji}$).
$TOTSALES_i$	Total change in trade and service sales in county i.
Edw_i	Direct change in employment by place of work in county i.
Edr_i	Direct change in employment by place of residence in county i.
Ydw_i	Direct change in income by place of work in county i.
Ydr_i	Direct change in income by place of residence in county i.
Etw_i	Total change in employment by place of work in county i.
Etr_i	Total change in employment by place of residence in county i.
Ytw_i	Total change in income by place of work in county i.
Ytr_i	Total change in income by place of residence in county i.
Me_i	Employment multiplier for county i.
My_i	Income multiplier for county i.
Ms_i	Sales multiplier for county i (employment multiplier used as proxy).

2.1 The Boundary Region

The boundary region is defined as a geographic area large enough to contain nearly all the "local" direct and indirect impacts from an AF action. The boundary region should be a largely self-sufficient economic unit with an important trade and service center. Bureau of Economic Analysis (BEA) Economic Areas are functional economic regions consisting of counties that have strong trade and commuting ties to a metropolitan center and consequently are well suited for selection as boundary regions.

2.2 Calculating the Change in Direct Expenditures

After the boundary region has been selected, the model will allocate the change in direct expenditures due to the action. Direct expenditures consist of: wages and salaries paid to military and civilian employees; base contracting; construction; and other. The following subsections explain how each of these direct expenditure items are calculated.

2.2.1 Wages and Salaries

The AFROI model classifies personnel in the following categories: permanent military, military trainee, civil service, nonappropriated fund (NAF) or base exchange (BX). A further distinction is made between personnel living on-base and those living in the region around the installation.

The AFROI model assumes the initial location of a change in wage and salary expenditures to be the employees' county of residence. The total change in wage and salary expenditures is calculated by summing the change in expenditures by each of the employment categories.

Since AF military employees and their dependents have BX privileges, a portion of their disposable income is spent on-base. By default, it is assumed that five percent of all expenditures made on-base by eligible personnel are indirect sales to suppliers located within the boundary region.* AFROI treats this source of impacts as a change in procurement expenditures rather than a direct change in wage and salary expenditures. This is discussed in the next section.

2.2.2 Base Contracting

Air Force purchases of goods and services are made through national procurement systems and the base contracts office. Purchases by the

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* See Pierce (1985, p. 9). This figure may be changed by the user if local conditions differ.

latter include such items as: supplies and equipment, fuel (non-aviation), services, utilities, communication, and transportation.

The AFROI methodology assumes that all services (e.g., janitorial and grounds-keeping services) are supplied from within the boundary region. (Services have a high proportion of labor and that labor is assumed to be from the local region.) Base contracting expenditures for materials are included only if contracts are held by firms headquartered in the boundary region. As previously mentioned, five percent of total BX and other expenditures made on-base by AF employees and their dependents is assumed, by default, to be indirect sales to suppliers located within the boundary region. This amount is calculated internally by the AFROI program, proportionally split between expenditures for goods and services, and added to base contracting expenditures.

Base contracting expenditures are then separated by the AFROI model into materials and labor components.* This is done to more accurately portray the local employment and income impacts associated with a change in the amount of goods and services purchased. The amount of expenditures for materials in a particular county is equal to the summation of non-service items and the material component of services. The amount of expenditures for labor is equal to the labor component of service expenditures.

2.2.3 Construction

The impacts from a change in construction expenditures are assumed to fall entirely within the boundary region, even if the home office of the contractor is located outside the area. It is assumed that the majority of construction workers will be hired locally regardless of the home base of the general contractor.** Since the boundary region is assumed to be largely self-sufficient, it is expected that most materials purchases will also be made locally. Construction expenditures are also separated into materials and labor components.***

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* Derived from the 1977 Input-Output Table for the U.S., SIC 734 (Services to Dwelling and Other Buildings). See U.S. Department of Commerce, Bureau of Economic Analysis (1984) The Detailed Input-Output Structure of the U.S. Economy, 1977. Volume 1, Table 1. The Use of Commodities by Industries, 1977.

** See Dunning (1981, pp. 57-74) for a discussion of the local, non-local workforce composition of Army Corps of Engineers construction projects.

*** Derived from the 1977 Input-Output Table for the U.S. Industry (Maintenance and Repair of Military Facilities). See U.S. Department of Commerce, Bureau of Economic Analysis (1984), The Detailed Input-Output Structure of the U.S. Economy, 1977. Volume 1, Table 1. The Use of Commodities by Industries, 1977.

2.2.4 Other Expenditures

In addition to wages and salaries, procurement, and construction expenditures, the Air Force often provides funding for programs related to the education and health of its employees and their dependents. The AFROI model assumes all these expenditures occur within the boundary region.

2.3. Initial Distribution of Direct Expenditures

The AFROI model assumes that the initial distribution of direct expenditures is given by the residential pattern of AF employees and the home office location of vendors and construction contractors. In situations where a complete accounting of this information is not possible, for example, new projects (i.e., those resulting in an increase of AF activity) and installations contracting with construction and service firms located outside the boundary region, the initial distribution of direct expenditures must be estimated before the region or area of influence can be defined. The following subsections describe how this is accomplished by the AFROI model.

2.3.1 A Gravity-Potential Model

The approach taken to estimate the initial distribution of direct AF expenditures is a generalized production-constrained gravity-potential model that estimates the "attraction" of each county as a function of county size, inter-county distances, and a distance parameter that reflects the friction of distance.

The gravity model is used to allocate direct expenditures from an action to counties within the boundary region when county specific allocations are unknown. This step is carried out for each of the four military and civilian direct employment categories, as well as procurement, construction, and other expenditures.

2.3.2 Size Measure

The main considerations in choosing a variable or set of variables to measure locational attraction are the type of interaction involved and availability of data. In determining the initial distribution of direct expenditures, the size measure is assumed to vary depending on the type of activity being allocated. For wages and salaries, total county population is used as the size measure to indicate the relative attractiveness of counties as places of residence. The size measure for procurement and construction expenditures is county trade and service employment which is used as a proxy measure of each county's economic influence. Finally, the "other" category of expenditures is also allocated according to total county population, since these payments are oriented primarily toward social welfare, e.g., education and health care.

2.3.3 Distance Measure

Inter-county distances in the AFROI model are the road distances between county population centroids. The distance between a county and itself is set at one-half the distance to the county's nearest neighbor. (Refer to Bloomquist, 1986 for further discussion.)

2.3.4 Distance Parameter

The distance parameter is an exponent on the distance term and its purpose is to specify the relationship distance has in determining the spatial distribution of a given activity. In the AFROI model a default value of 2 is assumed. This is consistent with several studies. For the sake of simplicity, this same exponent is used to allocate both AF employees and expenditures.

The AFROI program has an option to calibrate a value for the parameter which best reflects conditions for a specific region. In the AFROI model, the analyst is restricted to using county-level data since many of the inputs needed to conduct an impact analysis are only available for counties or county aggregates (e.g., SMSAs). Therefore, if most AF employees live and work in the same county, attempts to calibrate the parameter may not yield useful results. Nevertheless, for those cases where sufficient interaction is believed to exist, use of this option is recommended to obtain an estimate for the parameter that better reflects conditions specific to the site being studied.

2.4 Spatial Diffusion of Direct Expenditures

A core assumption of the AFROI model is that the full impact of an AF action is not likely to be restricted only to those counties receiving an initial change in direct expenditures. Due to trading activity and the shopping patterns of individuals, these impacts are spread among all counties of the boundary region to a greater or lesser degree.

The model estimates how much of the initial direct impact in county i (e.g., a change in wage and salary income paid to resident employees) remains in i and how much leaks to communities that have economic ties with county i. In other words, county j will attract to itself income change in i in proportion to the relative locational attraction of j with respect to i.

2.5 Impacts Calculation

Once the final distribution of direct expenditures is made, the next step is the calculation of direct and total economic impacts. Indirect impacts are implicitly defined as the difference between total and direct.

The AFROI model considers the effects of an AF action on three key economic variables: sales volume, employment, and income. These variables are considered to be key indicators of economic vitality.

In most impact studies the distinction between the location of place of work and place of residence impacts is often blurred. This may result in under or over-counting impacts for a given county because commonly an important percentage of people reside in a county different from the one in which they work. The AFROI model estimates the place of work and place of residence impacts for both employment and income. This procedure is explained in the subsections that follow.

2.5.1 Direct Impacts

The direct change in employment by place of work is found by dividing the direct change in sales volume by an average sales to worker ratio for the trade and service sectors in each county. For direct income impacts, an average wage for the trade and service sectors is estimated and multiplied by the direct change in employment. The change in income by place of residence also relies on the estimation of employment impacts.

2.5.2 Total Impacts

Total sales impacts in each county are calculated by multiplying the total change in direct sales by a sales multiplier. The AFROI model uses an employment multiplier as a proxy for the sales multiplier. AFROI calculates the total employment impacts by place of work and place of residence.

2.5.3 Working Dependents

Another component of employment change not considered thus far is the spouses and other dependents of AF employees who would leave the area and their jobs following a realignment action. In the AFROI model, the number of working AF dependents is calculated but not included as a separate source of employment and income impacts in defining the ROI. The reasons for this decision are as follows: first, many working dependents of Air Force employees hold NAF positions which are already counted among the direct employment impacts. Second, non-basic private sector jobs held by working dependents affected by a realignment action are accounted for by application of the economic base multipliers. Thus, listing working dependents as an additional source of net change in local employment and income would constitute double-counting. Third, jobs held by AF dependents in industries not reliant on military expenditures (e.g., other "basic" industries) would likely be filled by local unemployed workers or inmigrants; assuming adequate labor force mobility and availability of appropriate skills. Therefore, calculating the direct and indirect change in employment and income in the usual way

should account for the majority of impacts caused by the relocation of working AF dependents.

While AF dependents are not included as a source of income and employment impacts, their number is reported by place of residence and place of work. The AFROI model assumes that working dependents co[illegible]e, possibly to counties other than the one in which they reside, to take up jobs. It is further assumed that the number of dependents living in county i and working in county j is proportional to the size of the trade and service workforce in j and inversely related to the distance between i and j.

2.6 Adjustment of Impacts

After employment and income impacts have been estimated for each county, an adjustment is made to reflect the forecasted impacts for the entire boundary region. Although primarily an accounting procedure, this adjustment also reflects the influence of inter-county and associated feedback effects. These occur, for example, when two counties, i and j, export goods to each other. If an economic disturbance in county i decreases the demand for goods produced in county j, the reduction in j's income may result in lower imports from i. This, in turn, leads to additional repercussions in j. Impacts from this second source are known as feedback effects.

The adjustment procedure consists of applying regional multipliers to the total direct change in employment and income calculated for the entire boundary region and comparing these regional impacts to the sum of the individual county impacts. If the former is greater, county impacts are upwardly adjusted in proportion to the impacts already calculated for each county. If the sum of the county-level impacts exceeds the boundary region total impacts, no adjustment--either upward or downward--is made, the rationale is that it is better to present a "worst case" scenario than to assume impacts are less simply because of empirical difficulties in estimating the multipliers.

2.7 Testing the Significance of Impacts

The approach for determining which counties should be included in the ROI relies on a comparison of forecasted total county employment and income in each county, assuming no change in status of the military installation, to total county employment and income given that an AF action occurs. The intent is to include only those counties in the ROI that receive "significant" impacts, i.e., impacts that would not otherwise be anticipated given historical growth trends in economic activity. Because the relative magnitude of impacts is being compared, it is possible, using this approach, to include some counties in the ROI which experience smaller absolute changes in employment, for example, than counties that are not included. The reason for this, of course, is that a county having a small workforce (say, 5,000 workers) and losing

1,000 jobs is more likely to qualify as receiving significant impacts than a county with 50,000 employed and 2,000 lost jobs. What is considered important to measure, therefore, is not strictly the absolute change in employment or income but the relative hardship the county might experience as a result of changes affecting the local economic base.

Procedurally, the first step is to forecast by means of linear extrapolation employment and income by place of work and income by place of residence for each county assuming no change in the status of the installation.

The model also calculates the standard error of the forecast for each county and forecast year. This is carried out automatically by AFROI for a user-specified level of confidence. Visually, this process results in forecast curves above and below the primary forecast (see Figures 4.3 through 4.5). If, for example, a 90% confidence level is selected, there is 90% confidence that future change will fall within the envelope of the confidence band curves. It is assumed that an action that causes a level of change in excess, positive or negative, of the envelope is significant. Note that as the level of confidence increases, the confidence band increases in width. Thus, the threshold for significance is higher for a 90% level of confidence than a 60% level of confidence.

The remaining task is to compare the forecasted total employment and income for each county assuming no change in status of the military installation to the expected levels of activity given that an action change takes place. A county is included in the ROI if the expected change in total employment or income falls outside the confidence region surrounding the forecast line, in either the positive or negative direction.

3. AFROI APPLICATIONS

3.1 ROI and AOI

AFROI can be used to identify the ROI for an installation and determine the AOI for a particular action. In either case, AFROI will identify the counties affected and the degree to which sales volume, personal income, and employment are or will be affected by the AF activity being analyzed. AFROI can be used to estimate the effects of an increase or decrease in AF activity. These are defined as "gainer" and "loser" situations respectively.

To determine the ROI for an operating facility, run AFROI using data that describes the status quo conditions at the base.

To determine the AOI for a prescribed action (e.g., deployment of a new fighter wing, construction program, or personnel realignment) run AFROI using data that reflects the direct change rendered by the action. For example: the change in payroll, the change in the number of personnel living in a particular county, and the change in construction expenditures. If the action is to occur at an operating facility, the results of the AOI can be compared with those of an ROI run to obtain a perspective on relative impacts.

3.2 General Uses

Because AFROI estimates the geographical distribution of socioeconomic impacts it is well suited for several applications:

(1) Planning AFROI can be used to assist in planning AF programs. Its interactive feature facilitates the gaming and sensitivity analyses that are useful for identifying the effects of alternative methods of implementing contemplated actions.

(2) EIAP AFROI can be used to identify ROIs and AOIs for actions to be analyzed under the AF Environmental Impact Analysis Process (EIAP). If an EIS or LECS is required, AFROI can provide a first cut to be supplemented with other analytic tools appropriate to the level of detail required.

(3) ERIS AFROI can also identify the ROIs that are integral to the Economic Resource Impact Statement (ERIS) document prepared annually at each major AF installation.

3.3 Retirees

The economic contribution of an installation to an area is attributable to payroll and other expenditures. Because the presence of the base can influence retired military personnel to locate in the area, the economic contribution of retirees is indirectly attributable to the base. However, the program does not address retirees for the following reasons:

(1) An action (excepting a closure) should not affect the locational and spending patterns of retirees

(2) Retirees receive DoD retirement pay* as well as income from other sources including employment. Presently, there is insufficient information about retirees to accurately assess their economic contribution to an area.

(3) If a closure were to occur, it is not presently known the degree to which this would affect retirees presently in the region or influence future retirees.

If the user chooses to analyze retirees, it is recommended that a retiree-specific ROI be developed.

3.4 Base Closures

Again, for a closure, keep in mind that the use of AFROI to calculate the amount and geographic distribution of change will not take into account potential effects on retirees.

In the case of a base closure it is also important to identify which expenditures would actually be reduced. For example, the closure of an AF Logistics Command base does not necessarily mean that all contracting by that base will cease. The administration of contracts to procure services and materials may merely be shifted to another installation.

---

* Information on retirement pay and number of retirees by military service by 5-digit zip code areas can be obtained by request from the DoD Office of the Actuary located in the Pentagon.

4. USER GUIDE

4.1 Getting Into the AFROI System

4.1.1 Overview

AFROI is housed in ETIS which is interactive; that is, the user interacts with AFROI to enter data on a keyboard and examine output via a CRT (cathode ray tube) screen or printer. The program interacts with the user by prompting for information and presenting information needed by the user. The user does not need computer training because information is conveyed in conversational English.

The programs within ETIS, including AFROI, have menus or lists of options to choose from (see Figure 4.1). AFROI also includes a description of each option. Once in the program the user can move to and from the option of choice. Several of the fundamental techniques for operating within the program are presented in Appendix B.

4.1.2 Getting Set Up

To access AFROI the user will require the following:

(1) An account, login name for user identity, and password. Those working with the Air Force should obtain these through Ms. Linda Merritt at the headquarters of the Engineering Service Center (office symbol HQ AFESC/DEVP) at Tyndall AFB. All others should contact the ETIS Support Center at the University of Illinois, 707 Nevada Street, Urbana, Illinois, 61801, telephone number (217) 333-1369.

(2) An interactive terminal, that is, a computer terminal with a keyboard and a CRT or printout display.

4.1.3 Getting Into AFROI

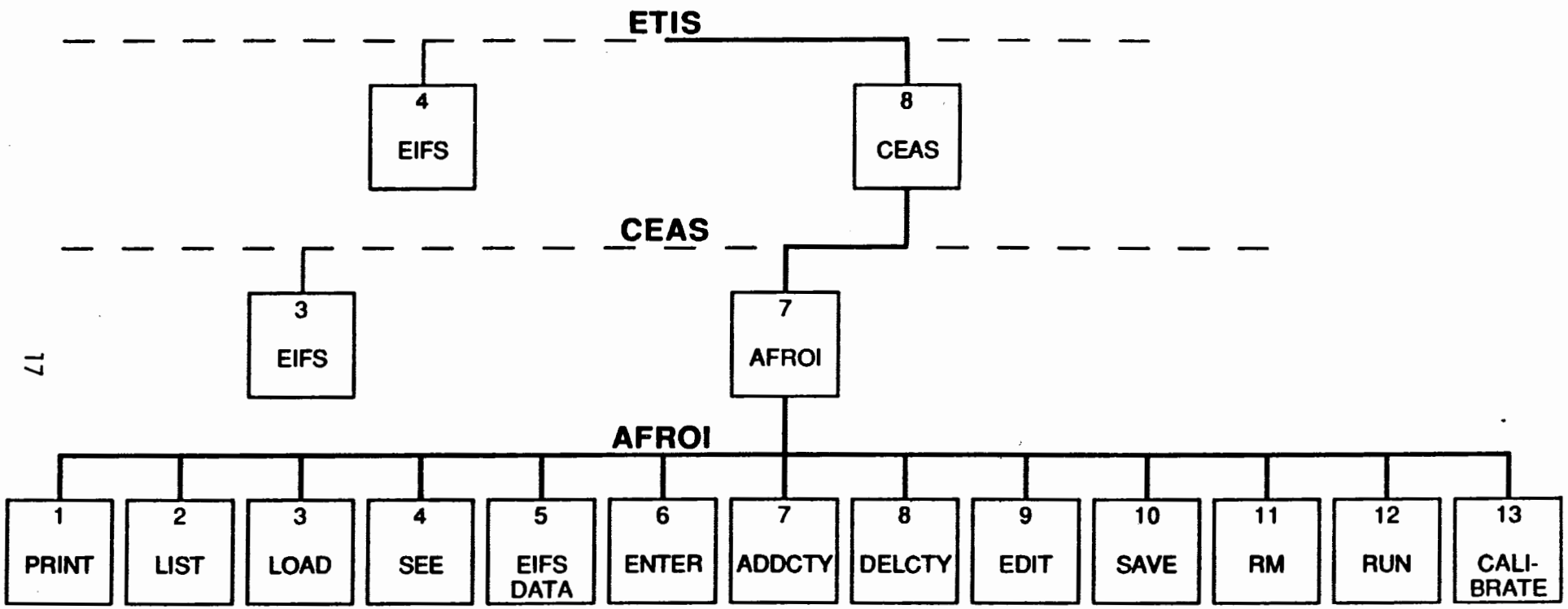
Once in operation, the user should follow these steps:

(1) Dial the UNIX telephone number (800/637-0958) and connect the terminal to the CERL computer via telephone

(2) Once connected and after the prompts, enter your login name and password

(3) Type "etis," after which a message will welcome you to ETIS and the computer will prompt "Which option? (press RETURN for menu):"

Figure 4.1 Organization of ETIS, CEAS, and AFROI



(4) Type "8" for option number 8, the Comprehensive Economic Analysis System (CEAS), and the welcoming message and the "which option" prompt will follow

(5) Type "7" for menu item number 7, AFROI, and the "which option" prompt will follow. At this juncture you can press the "RETURN" key to see the menu or type in the numeral of the desired option.

4.2 Description of AFROI Options

Once inside, the initial prompt is "AFROI--Which option?" If you choose to see the menu, the following information will be printed out.

```
AFROI--Which option? (Press RETURN for menu):
TYPE:                       TO:

  1 or print                Print a copy of the inputs
                            questionnaire
Data-Related Commands
  2 or list                 List existing data files
  3 or load                 Load inputs from a data file
  4 or see                  See the inputs you have loaded
  5 or eifsdata             How to load many AFROI inputs
                            using EIFS
  6 or enter                Enter inputs
  7 or addcty               Append county inputs
  8 or delcty               Delete county inputs
  9 or edit                 Examine/change inputs
  10 or save                Save inputs in a file
  11 or rm                  Remove a data file.

Model-Related Commands
  12 or run                 Run the impacts estimation model
  13 or calibrate           Calibrate gravity model exponent
  ? opt                     Get help on a menu option
  (q) quit                  Exit program
```

Each of these options is described below. Additional information may be acquired from AFROI directly by typing "?" followed by the number of the option of interest.

4.2.1 Option 1--Print a Copy of the Input Questionnaire

By typing a number "1" the input questionnaire will appear on the screen. This is a listing of all the inputs required to run the ROI

model. A hard copy printout of the input questionnaire (see Appendix C) can facilitate data collection and entry.

4.2.2 Option 2--List Existing Data Files

After you have entered data and at the time you exit AFROI, the model will ask if you wish to save the data with which you have been working and if so to create and name a file for the data. Upon reentering AFROI you may request Option 2 to obtain a listing of the files and when they were last modified and accessed, for example:

```
file name       last modified        last accessed
chanute         Feb 28 23:46 1985    Mar 4 22:07 1985
mthome          Mar 1 16:51 1985     Mar 1 16:51 1985
sample          Feb 8 22:16 1985     Feb 27 15:49 1985

3 file(s) total
```

4.2.3 Option 3--Load Inputs from a Data File

If you wish to review, modify, or otherwise use a data file you must first load it into the work area. Under Option 3, the program will ask, "Which file?" Entering the name of the file causes the program to load the file contents into the work area. Any data previously contained in the work area will be destroyed. Pressing "RETURN" will abort the process and return the user to the main menu.

4.2.4 Option 4--See the Inputs You Have Loaded

Once you have loaded a file (see Option 3), you may obtain a listing of all data in the work area or create a file in your directory outside AFROI. The program will print the following message:

```
Output file name? (Type RETURN to print to your terminal)
```

By pressing "RETURN" the contents of the workspace will be printed out on your terminal. By typing in the name of a file, the contents of your workspace will be duplicated and placed in a file in your directory. This is useful for storing a copy of your file and transferring or modifying it outside of AFROI. Refer to a UNIX handbook for more information on these capabilities.

4.2.5 Option 5--How to Load Many AFROI Inputs Using EIFS

Much of the data required to run AFROI is available in EIFS and can be automatically transferred from EIFS to your workspace. Option 5 prints out a message that describes which data is available in EIFS and

how to effect its transfer. This is described later under Retrieve EIFS Data in Section 4.3.3.

4.2.6 Option 6--Enter Inputs

This option is used to enter inputs from a terminal. Upon requesting Option 6 (or enter) the following prompt (and menu by hitting RETURN) is given:

```
Enter data for which section?  (Type RETURN for menu):
Type:  To Enter:
 1     Regional Inputs
 2     System Parameters
 3     County Inputs

 -     quit
```

The inputs for any section (or individual county) may be entered by typing the appropriate number command. The program will print a message identifying each variable and its current value in brackets "[]." To leave this value unchanged, type RETURN. Otherwise, enter the new value. Type a dash "-" to exit this option.

4.2.7 Option 7--Append County Inputs

New counties may be added to an existing data file using this option. For example, it may be of interest to explore how other counties affect the distribution of employment and income impacts in an area. This option permits these data to be easily added to an existing file. Once the new county(ies) is (are) added, the user must adjust the regional inputs to reflect the enlarged area. In most cases, this means merely recalculating the employment and income multipliers for the boundary region.

When option 7 is requested the user is given the prompt:

```
Append which file?
```

On typing the name of an existing file (hitting RETURN aborts this option), the county inputs currently in your workspace are appended to the named file. This file is then automatically loaded into your workspace with the added county inputs. No check is made for counties entered more than once. Counties entered more than once must be removed (Option 8).

4.2.8 Option 8--Delete Inputs for a County

You may delete inputs for a single county using this option. Type the number (or name) of the county you want deleted from your work area when the program prompts with "Delete which county?" When done, the

program will print the message: "(name) deleted" and return to the main menu.

4.2.9 Option 9--Examine/Modify All Inputs

Option 9 allows you to modify data currently in the work area. Data inputs are grouped by section. On requesting Option 9 the program will respond with the menu:

```
Type:  For:
 1     Regional Inputs
 2     System Parameters
 3     County inputs

 -     To return to top level

Edit which section?
```

Each of these sections contains a menu of entries. These are as follows:

```
Section 1  Regional Inputs
Type:  For:
 1     Project name
 2     County where base is located
 3     Year of completion of action
 4     Regional employment multiplier
 5     Regional income multiplier
 6     Total number of affected personnel
 7     Number of affected personnel by class
 8     Average wage of affected personnel
 9     Dollar amount change in regional AF expenditures

 -     to quit editing "Regional Inputs"

Section 2  System Parameter
Type:  For:
 1     Working dependents full time equivalency factor
 2     Fraction of working dependents
 3     Fraction of AF employees living on-base
 4     Fraction of income spent in boundary region (on-
       and off-base)
 5     Fraction of income spent off-base by persons
       living off-base
 6     Fraction of income spent off-base by persons
       living on-base
 7     Fraction of construction expenditures for labor
       and materials
 9     Fraction of BX sales from local suppliers for
       labor and materials
```

```
10      Gravity model exponents
11      Forecast confidence level
12      CPI Price deflators

 -      to quit editing "System Parameters"

Section 3  County Inputs
Type:  For:
 1      County name
 2      Total population
 3      Employment multiplier
 4      Income multiplier
 5      Number of affected personnel by class
 6      Dollar amount change in expenditures
 7      Trade and service employment
 8      Trade and service sales per worker
 9      Trade and service income per worker
10      Service income per worker
11      Construction income per worker
12      Distance between county population centroids
13      BEA employment by place of work
14      BEA total income by place of work
15      BEA net income by place of residence

 -      to quit editing "County Inputs"
```

When an entry is selected, the existing values are printed followed by the question:

Do you want to change anything? [No]

A response of "no," "n," or simply RETURN will leave the value unchanged and return the user to the entry selection prompt. Answering in the affirmative will cause the program to prompt for new values for each entry item.

You may examine inputs in any order. However, keep in mind that changes made in one section may require changes in other sections. For example, changing the number of military personnel in one county may necessitate changing the total number of military and civilian personnel at the boundary region level. The program checks for these possible inconsistencies prior to calculating impacts and reports likely errors.

4.2.10 Option 10--Save Inputs in A File

You can store your inputs in a file using this option. The program will ask:

Save file name?

Typing RETURN will abort the process and return you to the main menu. If you type the name of an existing file the program will warn:

That file already exists.
Do you really want to over-write it? [No]

Typing RETURN (or "no") prevents the file from being overwritten. A response of "y" or "yes" will overwrite the field with the current contents of the work area. File names consist of 1 to 12 letters, digits, and some punctuation marks; it is recommended that punctuation be limited to periods, commas, colons, dashes, sharps ("#"), pluses ("+"), and parentheses. Spaces between letters and so forth are not desirable. Once the program has determined the name of the file in which the inputs are to be stored, the contents of the work area are written to the file, and the program returns to the main menu.

4.2.11 Option 11--Remove a Data File

You can remove old data files using this option. The program asks:

Remove which file?

If you type the name of a file that does not exist, the program prints the message:

filename: can't access file.
Try again or type RETURN to abort.

Otherwise, if the file is found it is removed silently and the user is returned to the main menu.

CAUTION: Once a file is removed it is gone forever. Therefore, make sure the file is no longer needed before removing it.

4.2.12 Option 12--Run the Impacts Estimation Model

This option will execute the impacts estimation model on the set of inputs currently loaded in the work area. You must first specify if the action represents an increase or decrease in activity. (This merely serves to identify the estimated impacts as positive or negative values.) Indicate a decrease if you wish to determine the ROI. To specify the type of action, type a 0 or 1 (whichever is appropriate) to the following prompt:

Type '1' if action represents an increase in activity
'0' otherwise:

If you have not completely specified the county distribution of employee places of residence or base expenditures, you may request AFROI to do this for you. The program will give the prompt:

Do you want AFROI to allocate any unassigned employees or expenditures? [Yes]

A response of "y" or RETURN will cause the program to automatically distribute any employees and/or expenditures that you have not allocated to a specific county and print to the terminal both the variable name and amount allocated. A response of "n" or "no" to the above question indicates that you wish to manually specify the geographic distribution of these variables. If any variable is not completely allocated, the program will print a message identifying the variable and the amount unallocated and abort the run. Modifications to the input data can be made with Options 6 or 9.

When the input data set is complete, the model will run and print the message:

Doing calculations. One moment please ...

The time required to complete a run will depend on current system activity and the number of counties that make up the boundary region for the study. For studies with 10 or fewer counties and low system activity, AFROI should finish almost immediately. For boundary regions having more counties or when the program is used at times when user demand on the computer is heaviest (9AM to 4PM Central time) a run will require more time. However, for most runs, elapsed time should not exceed 30 seconds.

When finished, the program will print the message

Type:	To Display:
1	Inputs
2	Outputs in table form
3	Time-series plots of significance of impact
-	Return to main menu

Which Option?

Menu Item 1

Typing "1" will yield the following message:

Output file name? (Type RETURN to print to terminal)

Inputs will be saved in the file you designate (or printed on the terminal by hitting RETURN). This file is created in your current working directory.

After a file (or terminal) is specified, the user is presented with the next prompt:

Type:	For:
1	Regional inputs
2	System parameters
3	County inputs
*	All inputs
-	quit

Inputs you want to see or print to file?

Menu Item 2

Typing "2" will yield the following message:

Specify the output table(s) you wish to print
(Type RETURN for menu):

Hitting RETURN prints the menu

Table:	Title:
1	Place of Residence of Base Personnel
2	Initial Distribution of Base Contracting Expenditures
3	Initial Distribution of Construction Expenditures
4	Initial Distribution of Other Expenditures
5	Change in Sales Volume, Employment, and Income
6	Change in Employment and Income by Place of Residence
7	Significance of Place of Work Impacts
8	Significance of Place of Residence Impacts
9	Installation-Specific Multipliers for Place of Work Impacts
10	Installation-Specific Multipliers for Place of Residence Impacts
*	All tables
-	quit

Specify the table(s) you wish to print
(Type RETURN for Menu):

Again, any single table (or all tables) may be printed. Tables 7 and 8 will identify the counties in the ROI and AOI. After a table number is specified, AFROI will ask whether the output is to be placed in a file or printed on the terminal. Typing a dash "-" exits the print tables menu.

Menu Item 3

Typing "3" will yield the following prompt:

```
Type:  To Plot:
 1     Employment by place of work
 2     Income by place of work
 3     Income by place of residence

 -     quit

Plot which variable?
```

Through this menu the user can graphically display a regression plot, confidence bands and calculated impacts (employment or income) for a single county. This procedure may be repeated as often as desired by selecting the desired plot from the menu.

4.2.13 Option 13--Calibrate Gravity Model Exponent

This option is used to calibrate the gravity model exponent used in the ROI definition model. You can accept the default exponent used by the program or with the assistance of this option verify its appropriateness and/or identify a new exponent if warranted. The procedure adjusts the friction of distance exponent up or down to maximize total interaction in the region subject to constraints on both mean journey-to-work trip length and the "attractiveness" of competing destinations.

Inputs include:

1) Total population which is used to measure the relative attractiveness of each county in the boundary region (supplied by program)

2) Inter-county distances (supplied by program)

3) An average trip length for the journey-to-work. If the place of residence of AF employees is known, an average trip length is calculated for the region given the above information. Otherwise, the user must specify this item. The average length of journey-to-work trips for AF employees living off-base was calculated from one source (Gunther, 1982) to be approximately 9.5 miles. Typical values range from 6 to 15 miles.

4.3 How to Use AFROI

The five major steps to use the AFROI model are described below and summarized in Figure 4.2.

4.3.1 Step 1, Collect Data

Date to run AFROI data will be obtained from three sources: EIFS, AFROI, and the field. The data parameters, sources, and so forth are described in detail in Section 4.4.

Much of the data is maintained in EIFS and can be acquired in the manner described in Option 5 of AFROI (see Step 3). Other inputs (i.e., System Parameters) have been developed from AF surveys (Gunther, 1982) and are housed in AFROI. These values can be accepted or overriden if better information is available (see Step 4). The third category of data must be gathered by the user and manually entered via the interactive keyboard.

The data should be obtained from the primary sources and entered into the data tables in Appendix D and on a hard copy of the data questionnaire (see Option 1 of AFROI and Appendix C). The data tables provide a useful format for organizing the county and regional inputs that are specific to the installation or action. These tables are also included in the manual describing how to prepare an ERIS. Therefore, the information required for the data tables should be available in the ERIS which is prepared annually at major AF installation. After completion of the tables, the data should be transferred onto the data questionnaire with the other field information. The data questionnaire lists the information in the order in which it is to be entered into the program. Use it to facilitate data entry.

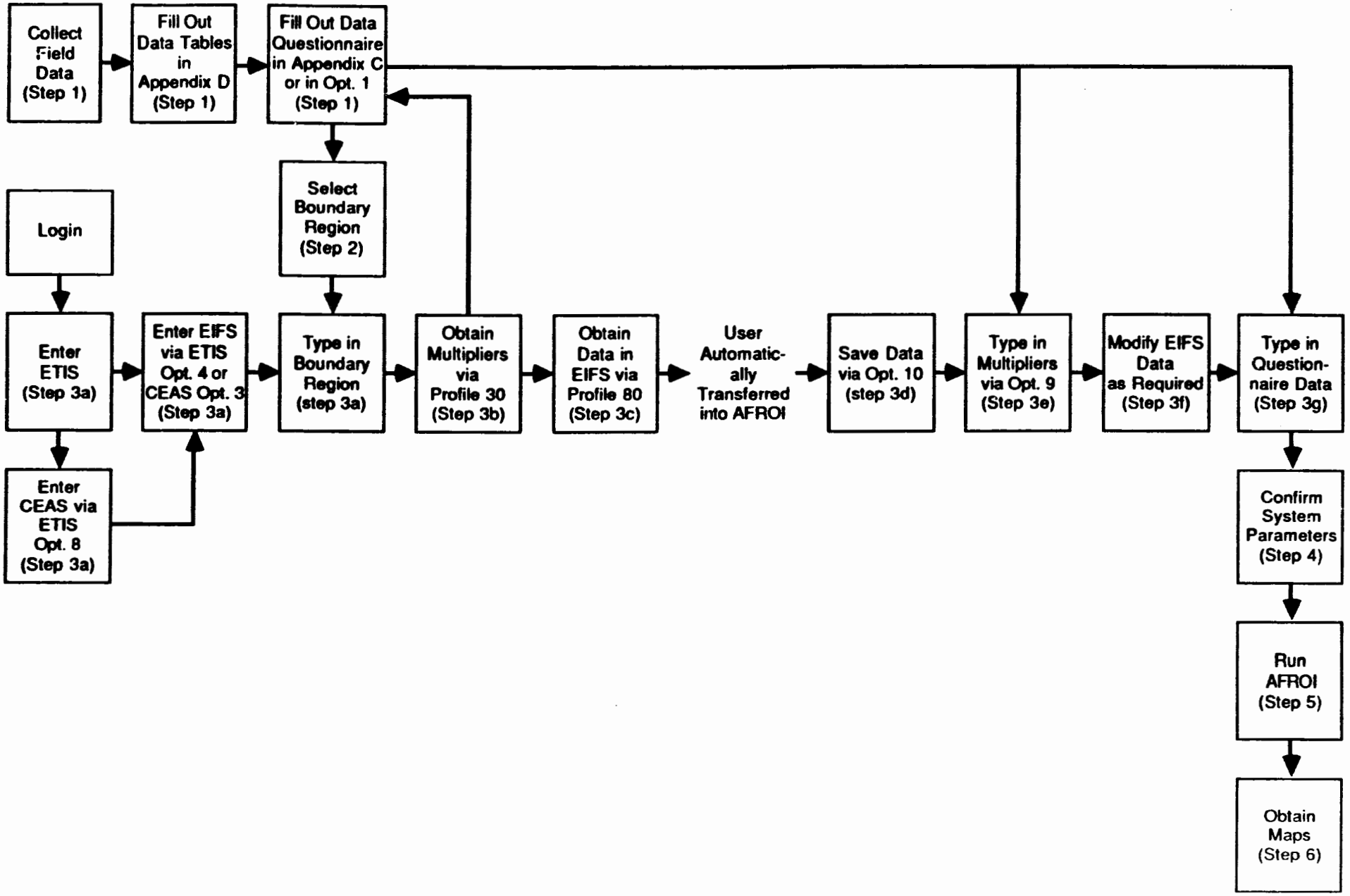
4.3.2 Step 2, Identify Boundary Region

The boundary region is the geo-economic unit in which the installation or activity being analyzed is located. This area is analyzed to determine the amount of county-specific socioeconomic change. The ROI and AOI will be subsets of the boundary region. Thus, the boundary region should include all counties that may potentially have significant economic interaction with the installation. Because the model considers the economic interaction between counties, the boundary region should be an economic unit with an important trade and service center.

It is recommended that the Bureau of Economic Analysis (BEA) region in which the base is located be selected as the boundary region. If the base is on the fringe of a BEA region, the adjoining region(s) should also be included. A list of BEA regions and their constituent counties is available in EIFS.

A list of BEA regions can be obtained from EIFS by entering "?beas" after the prompt, "First county or region." If the name of the BEA

Figure 4.2 How to Use AFROI



region is entered after the "First county or region" prompt, the program will print a list of the counties in the BEA region, their populations, and areas.

For an existing activity, the field data will identify the counties affected by AF payroll, construction, procurement and other spending. Each county where this spending is not trivial should be included in the boundary region. This may necessitate the inclusion of counties or BEA regions outside or perhaps non-contiguous with the BEA region of the installation. For example, in FY84, Robins AFB, which is located in the Macon, Georgia BEA region had over $100 million in contracts with firms 100 miles away in Atlanta, which is in the Atlanta, Georgia BEA region. In this case, the boundary region should be comprised of both BEA regions.

4.3.3 Step 3, Enter Data

One way to enter the data is to first enter EIFS and transfer the data to AFROI as described in Steps 3a through 3f. This will create data sets for each county. Following this, the information collected in the field (Step 1) can be entered via Options 6 and 9.

Step 3a, Access EIFS

Enter EIFS in much the same manner as described in Section 4.1, except once in ETIS select Program 4--EIFS. EIFS can also be accessed via Option 3 in CEAS, which is Program 8 in ETIS. After some introductory information the program will prompt:

First county or region (type ? for help):

Type in the name of the BEA region (do not forget to identify the state) and the program will prompt:

Next county or region (type RETURN if done):

Any other BEA region or county would be entered at this point. Once the region has been specified the program will state "You have selected:" and will list the names of the counties and states, their 1980 population, and area or square miles. The program will then prompt:

EIFS V2.8 - What profile? (cr) to see list):

There are two profiles of interest: 30 which contains employment and income multipliers and 80 which contains other information required for AFROI.

Step 3b, Access Profile 30

First specify Profile 30 by typing "30 by county." The program will respond by listing the counties in the boundary region and their

respective multipliers. The multipliers should be manually copied on the input questionnaire or extracted in hard copy from the system. Later, (Step 3e) it should be entered manually into AFROI via Option 6 or 9.

Step 3c, Access Profile 80

By specifying Profile 80, the program will automatically gather the data identified in Option 5, transfer it to AFROI, identify data deficiencies, and move the user back into the AFROI program. This will occur within seconds for regions containing less than 15 counties.

Step 3d, Save EIFS Data

Once back in AFROI, it is advisable to elect Option 10 and create a file to store the EIFS data.

Step 3e, Enter Multipliers

This can be done by specifying Option 9; then, Section 3, County Inputs; then, entry 3, Employment Multiplier. At this point, the program will prompt:

Which county (type RETURN for list):

By responding with a "*", the program will go through the counties one by one allowing the user to enter the employment multipliers gathered in Step 3e. The same procedure should be used for entry 4, Income Multiplier.

Step 3f, Modify or Augment EIFS Data

Although it is not necessary, you may modify or update the EIFS data via Option 9. For example, EIFS contains the most recent BEA estimate of county population (in 1986, this was the 1982 estimate); this can be updated if more current information is available. Similarly, the time series for county income and employment can be augmented with information for the most current years.

Step 3g, Enter Questionnaire Data

The information that has been collected and manually entered into the questionnaire (see Step 1) should be entered via the interactive keyboard and Options 6 and 9.

4.3.4 Step 4, Confirm AFROI System Parameters

The values for several parameters have been preset. These should be reviewed to verify their appropriateness to the case being analyzed.

Usually changes will not be necessary, except to Entry 3, fraction of AF personnel living on-base. Within Options 6 and 9, Section 2, there are 12 categories of entries:

- Entries 1 through 9 were developed from AF surveys of selected bases
- Entry 9, fraction of BX sales entering the local economy, is set at 5% and is a rough estimate
- Entry 10, gravity model exponent, is set at 2.00. It can be modified in accordance with Option 13
- Entry 11, forecast confidence level, defines the threshold at which a county is recommended for inclusion in the ROI or AOI. (Refer to Section 2 for more discussion). The confidence level is set at 90%. The threshold may be lowered by decreasing the confidence level.
- Entry 12, the CPI price deflators which are used to adjust all dollar figures to constant dollars. The price deflators will be updated periodically by CERL, but can be modified by the user.

The menu within Option 9, Section 2 identifies the 12 entries and by typing the appropriate entry number, the user gains direct access to the entry of interest. The program will display the preset value and ask the user whether it is to be changed. After responding in the affirmative, the new value can be entered. Changes can also be made using Option 6.

4.3.5 Step 5, Run AFROI

Option 12 is used to run AFROI and the description of how to run this program is presented in Section 4.2.12. The tabular and graphic outputs of the program are described in detail in Section 4.5. The outputs are designed to provide several tools for analyzing and displaying the output. The counties recommended for inclusion in the ROI or AOI are identified with an "*" in Tables 7 and 8 (generated by the program).

4.3.6 Step 6, Obtain AFROI Maps

Computer generated maps depicting the ROI and AOI counties and other pertinent AFROI findings can be developed outside ETIS in the manner described in Appendix E. This step is optional but highly recommended.

4.4 Description of Data Inputs

The discussion that follows describes each of the parameters that is used by AFROI in the order in which they appear on the data questionnaire and are entered into the program. The name of each parameter is followed

by a brief description, a discussion of issues that are important to selecting the proper value for the parameters, and sources for each variable. The sources will include EIFS, AFROI and a variety of primary sources.

4.4.1 Regional Impacts

The regional inputs describe the total and regional (in the case of non-service contracting) direct economic impact of the installation or activity. All of this data is to be collected in the field or from site specific documents. The only exceptions are the regional multipliers which pertain to the boundary region and are found in the EIFS data base.

Project

Definition: The project name.

Discussion: The project name should succinctly describe the nature of the analysis, for example, Tinker AFB ROI or Mountain Home AFB OTH-B Radar AOI. The project name will appear in the title of the AFROI output.

County Where Base or Activity is Located

Discussion: Some bases or activities are located in more than one county. Only one county should be selected for this entry and it should reflect the place where the bulk of the economic activity will occur. If the activity is geographically disaggregated, it may be necessary to develop AOIs for each center of activity.

Year of Completion of Action

Discussion: AFROI will forecast employment, income, and sales volume in the year in which the action is completed, and the significance of impacts will be determined for that year.

Regional Employment Multiplier

Description: The regional employment multiplier relates a change in basic employment to the total change in employment in the boundary region.

Source: EIFS data automatically transferred to AFROI (refer to Section 4.3.3, Enter Data).

Regional Income Multiplier

Description: The regional income multiplier relates a change in basic income to the total change in income in the boundary region.

Source: EIFS data automatically transferred to AFROI (refer to Section 4.3.3, Enter Data).

Total Number of Affected Personnel

Description: The affected personnel are those persons directly affected by the action.

Discussion: The total number of affected personnel is the summation of the classes of personnel listed in the subsequent sections. When identifying an ROI, this is equal to all persons assigned to the base. For an AOI it is only the people affected by the activity under consideration.

If there are personnel affected by the action that do not fall into the classifications provided, they should be combined with the most appropriate category. For example, foreign or non-AF military that are affected, should be added into one of the two military categories.

If there is a significant number of civilian contractors associated with the installation (e.g., on-site contractors working on the Space Shuttle Program at Vandenberg), they should be included in the Civil Service category.

Number of Affected Personnel: Permanent Military

Description: Military permanent party are AF military personnel assigned to the installation for purposes other than to receive training.

Source: Personnel Systems Management Branch; ERIS.

Number of Affected Personnel: Military Trainees

Description: Military trainees are AF personnel located at an installation to receive training.

Source: Personnel Systems Management Branch, ERIS.

Number of Affected Personnel: Civil Service

Description: Civil service personnel are those federal employees working for the AF whose salary and wages are paid from Congressional appropriations.

Source: Civilian Personnel Office; ERIS.

Number of Affected Personnel: Nonappropriated Fund (NAF)

Description: NAF personnel support Morale, Welfare, and Recreation (MWR) activities and are paid from the operating revenues of those activities rather than through Congressional appropriations.

Discussion: Many NAF personnel work part time and some are military dependents.

Source: Civilian Personnel Office; ERIS.

Number of Affected Personnel: Base Exchange (BX)

Description: The BX system is an independent entity that serves Army and AF installations and pays its employees from operating revenues.

Discussion: Like NAF employees, many BX employees work part time and are military dependents.

Source: BX Manager, ERIS.

Average Wages of Affected Personnel

Description: The average wage is the total annual payroll for each of the categories of personnel divided by the average annual number of personnel in that classification. Payroll is defined as gross income (which is pay before deductions for income tax withholding and social security tax but does not include retirement and other benefits that are not received directly by the payee).

Discussion: The permanent duty station of trainees will vary according to the length of stay at the installation where they are receiving training. Usually, if the training period is to exceed six months, trainees will be assigned to the training base. Otherwise, they will be on temporary duty (TDY) status, and their permanent duty station will be other than the training base. This can complicate gathering data on payroll because those trainees on TDY will be paid by their home bases and records at the training base may not reflect this transaction. If

this is the case, the payroll for all trainees can be estimated by applying the average pay for non-TDY trainees to the TDY trainees.

Nearly all major installations will have representatives of the U.S. Army Corps of Engineers to administrate the Military Construction Program (MCP). Some bases, particularly those with training activities, will have contingents from the other services and foreign countries. In some cases payroll for other U.S. military is handled by the host installation. Care must be taken to identify the entities that distribute payroll for non-AF military. The payroll for these individuals should be included with appropriate category of military personnel.

Sources: Permanent party military, military trainee, civil service--Accounts and Control Branch, Accounting and Finance Office, ERIS; NAF-NAF Financial Management Office, ERIS; BX--BX Manager, ERIS; Other--tenants administrative, personnel, or payroll office.

Dollar Amount Change in Regional AF Expenditures

Description: This is the total annual change in expenditures due to the action.

Discussion: When identifying an ROI, the change is equal to the total annual amount of expenditures in the region at the installation under normal operating conditions. For the AOI, the annual change is that associated with the action itself. If the action occurs over a period in excess of 1 year, the inputs should be annualized. For a major new program, it may be desirable to determine the AOI for the year in which the maximum amount of construction occurs and the AOI for the post constuction steady state operation. Similarly, for a personnel realignment the year in which the maximum amount of change will occur could be used.

Dollar Change; Base Contracting (Services)

Description: This category includes contracts for services (rather than goods) that are provided locally.

Discussion: Service contracts are distinguished by the high labor component. In some cases it may require judgment to classify the type of contract. However, major service contracts are usually readily apparent and typically include: janitorial, grounds maintenance, and food services. Construction services should be included under construction, not services. The total amount of service contracts, regardless of the location of the vendor, should be used. In addition to service contracts, this category can include expenditures in the local economy by

personnel on temporary duty (TDY) when deemed significant and not included in other model parameters.

Source: Base Contracting Office.

Dollar Change; Base Contracting (Total)

Description: Total contracting includes all service (see above) and non-service contracts, for example, supplies, equipment, utilities, and transportation. (Construction contracts are not included.)

Discussion: The dollar change in non-service base contracting should include only the change expected to occur in the boundary region. This is normally achieved by including only those vendors located in the boundary region.

Source: Base Contracting Office; ERIS; project engineer of activity.

Dollar Change, Military Construction Program

Description: MCP includes large scale (usually over $500,000) construction for mission support.

Discussion: The MCP is administered by the U.S. Army Corps of Engineers. Each construction project must receive Congressional approval and appropriations. MCP expenditures may vary radically from year to year. Therefore, when identifying the ROI for a base, use an amount for MCP that reflects the anticipated level of expenditures based on program estimates and historic (5-year) spending levels. When identifying an AOI, use the engineering cost estimates for the MCP portion of the job. The dollar change in contracting should equal the total change regardless of location of contractor.

Source: Base Civil Engineer, Construction Status Report*; Project engineer activity; ERIS.

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* The Construction Status (or Management) Report is typically generated and maintained at base level. The AF-wide CECORS is an alternative source. These reports provide a snapshot of contracts underway at a particular time. Actual yearly expenditures should be estimated (based on contract duration) or obtained from the accounting and finance office.

Dollar Change, Operations and Maintenance (O&M) Contract Construction

Description: O&M construction includes minor repairs, modifications, and maintenance.

Discussion: O&M construction is funded at base level and the amount expended remains relatively constant compared with other construction programs.

Source: Base Civil Engineer, Construction Status Report; ERIS.

Dollar Change, Nonappropriated Fund (NAF) Construction

Description: NAF construction includes new construction, repairs, and modifications of NAF facilities.

Discussion: Funds are obtained from the proceeds of NAF activities. NAF expenditures may vary radically from year to year. Therefore, estimate spending using the methods suggested for MCP.

Source: Base Civil Engineer, Construction Status Report; ERIS.

Dollar Change, Military Family Housing (MFH) Construction

Description: MFH construction includes projects to renovate or upgrade military family housing. (The construction of new housing is usually administered by the MCP.)

Discussion: Spending for MFH can also vary considerably from year to year. Therefore, estimate MFH expenditures using the methods suggested for MCP.

Source: Base Civil Engineer, Construction Status Report; ERIS.

Dollar Change, Other Construction

Description: Other construction activities are carried out as part of special programs such as the Space Shuttle and Over the Horizon Radar.

Discussion: Usually these programs are funded and administered by entities not associated with the host base. However, the conventional construction portion of such programs may be conducted through the MCP and therefore should be included in the MCP on-base category. These are typically one time programs with the bulk of funds expended over a defined time period.

Source: Information on the non-MCP portions of these programs should be obtained from the command administering the construction or procuring the system being installed; ERIS.

Dollar Change, PL 81-874, Public School Program

Description: Payments to school districts are comprised of Public Law 81-874 funds provided to public schools.

Discussion: Most public school districts derive a significant proportion of their revenues from property taxes. Because federal facilities are not subject to local property taxes, through PL 81-874 funds are provided to public school systems based on average daily attendance. Total funds equals the summation of funds received by each eligible district. Where a district services more than one military facility, care must be taken to estimate the funds attributable to the installation of interest.

Source: Administrative office of each school district serving base dependents, ERIS.

Dollar Change, CHAMPUS and Supplemental/Cooperative Care

Description: These categories include payments to physicians and medical facilities through the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) and the Supplemental/Cooperative Care programs.

Discussion: These programs permit active duty military, military retirees, and dependents to seek medical care when the required services are not available from a military medical facility or when travel to that facility creates a hardship. The precise geographic distribution of these expenditures is generally unavailable. Therefore, the distribution should be estimated based on the location of major medical facilities.

Source: Base Hospital, Resource Management or Clinic Resource Advisor; ERIS.

Education Programs

Description: These programs are comprised of expenditures by the federal government to defray the tuition expense of military personnel attending private educational institutions.

Discussion: The location of tuition expenditures should be estimated. Tuition of national schools that provide instruction on-base should be attributed to the place of instruction. Assistance payments

for local schools and colleges should be attributed to the location of the institution.

Source: Base Educational Officer.

4.4.2 System Parameters

Working Dependents Full Time Equivalency Factor

Description: This factor describes the average amount of time spent on the job by dependents of AF employees.

Discussion: The default value is 0.5 or half time.

Source of Default Value: Gunther, 1982.

Fraction of Working Dependents

Description: The fraction of working dependents is that fraction of AF dependents that are employed.

Discussion: The default values by category of AF employee is as follows: permanent military, 0.25; military trainee, 0.25; civil service, 0.37; and NAF and BX, 0.37.

Source of Default Value: Gunther, 1982.

Fraction of Employees Living On-Base

Description: This is the fraction of AF employees by category that reside in on-base housing.

Discussion: This fraction can vary considerably from base to base because it is a function of the number of military, the number of civilians, and the amount of occupied on-base family and bachelor housing units. There are two approaches to identifying the fraction. The preferred approach is to derive the fraction by dividing the number of personnel in each category living on-base by the total number of employees in the respective category. Due to a lack of data, it may be necessary to estimate the fraction of civil service and NAF/BX employees living on-base. Both of the following methods should be used and the results compared to judge which is most applicable.

Fraction of Civil Service Living On-Base =

$$\frac{(\text{Total No. of Military Living On-Base}) \times (0.038)}{(\text{Total No. of Civil Service})}$$

Fraction of NAF/BX Living On-Base =

$$\frac{\text{(Total No. of Military Living On-Base)} \times (0.025)}{\text{(Total No. of NAF/BX)}}$$

and

Fraction of Civil Service Living On-Base =

(Total No. of Civil Service) x (0.047)

Fraction of Civil Service Living On-Base =

(Total No. of NAF/BX) x (0.158)

Fraction of Income Spent in Boundary Region

Description: This is the fraction of disposable income that is initially spent by AF personnel in the boundary region.

Discussion: The default values by category of AF personnel are as follows: permanent military, 0.677; military trainee, 0.582; civil service, 0.671; and NAF/BX, 0.815.

Source of Default Value: Gunther, 1982.

Fraction of Income Spent Off-Base by Persons Living Off-Base

Description: This is the fraction of disposable income spent off-base by AF personnel and their dependents living off-base.

Discussion: The default values by category of AF personnel are as follows: permanent military, 0.491; military trainee, 0.378; civil service, 0.618; and NAF/BX 0.693.

Source of Default Value: Gunther, 1982.

Fraction of Income Spent Off-Base by Persons Living On-Base

Description: This is the fraction of disposable income spent off-base by AF personnel and their dependents living on-base.

Discussion: The default value by category of AF personnel are as follows: permanent military, 0.491; military trainee, 0.378; civil service, 0.618; and NAF/BX, 0.693.

Source of Default Value: Gunther, 1982.

Fraction of Construction Expenditures for Materials and Labor

Description: These factors describe the fraction of construction contract amount that is on average spent by the contractor for materials and labor.

Discussion: The default values are as follows: Materials, 0.60 and Labor, 0.384.

Source of Default Values: 1977 National Input/Output table.

Fraction of Contracted Service Expenditures for Materials and Labor

Description: These factors describe the fraction of service a contract that is on average spent by the contractor for materials and labor.

Discussion: The default values are as follows: Materials, 0.183 and Labor, 0.524.

Source of Default Values: 1977 National Input/Output tables.

Fraction of BX Sales from Local Suppliers

Description: This describes the amount of purchases by the BX in the ROI as a fraction of BX gross sales.

Discussion: The default is 0.05.

Source of Default Value: Rough estimate based on anecdotal information (Pierce, 1985 and 1986).

Gravity Model Exponent

Description: This is the exponent for the gravity model within AFROI that is used to geographically distribute employment and spending.

Discussion: In most cases the exponent will equal the default value of 2.00. This can be verified using Option 13.

Source of Default Value: Bloomquist, 1986.

Forecast Confidence Level

Description: The forecast confidence level is the level of confidence expressed in terms of a percent that a given forecasted value will fall within a standard deviation of the projected value.

Discussion: The default confidence level is 90%.

Source of Default Value: The default value is typical for statistical analysis and through field tests of AFROI has produced reasonable results.

CPI Price Deflators

Description: The consumer price index price deflator is the ratio of the costs of a given set of goods referenced against a base year.

Discussion: The CPI price deflator is used to convert income and expenditures to a common base, thus isolating the effects of inflation. The price deflators in AFROI will be updated by CERL periodically. The CPI indices can be replaced by others as appropriate. For example, if an activity involves primarily construction, the most current construction cost index could be used.

Source of Default Value: Bureau of Economic Analysis, Survey of Current Business.

4.4.3 County Inputs

The county inputs are county-specific information that should be entered for each county in the boundary region. Much of the general county information is available in EIFS (see Option 5) and the information about the base or action should be collected and entered by the user.

Population for (county)

Description: This is the total population in the county.

Source: EIFS. The user may provide updated information if available.

Employment Multiplier for (county)

Description: The county employment multiplier relates a change in basic employment to the total change in employment in the county.

Source: EIFS data manually transferred to AFROI (refer to Section 4.3.3, Enter Data).

Income Multipliers for (county)

Description: The county income multiplier relates a change in basic income to the change in total income in the county.

Source: EIFS data manually transferred to AFROI (refer to Section 4.3.3, Enter Data).

Number of Affected Personnel By Class in (county)

Definition: (Refer to Section 4.4.1)

Discussion: If there are no persons within a particular class living in the county, enter zero.

Source: (Refer to Section 4.4.1).

Changes in Expenditure for (county)

Description: (Refer to Section 4.4.1)

Discussion: If there are no expenditures within a particular category, enter zero.

Source: (Refer to Section 4.4.1).

Trade and Service Employment in (county)

Description: This is the employment within the trade and service sectors of the economy of the county.

Source: EIFS.

Trade and Service Sales per Worker in (county)

Description: This is the average gross sales per worker in the trade and service sectors.

Discussion: Sales per worker is calculated by dividing total sales by total number of workers in the trade and service sectors.

Source: EIFS.

Trade and Service Income per Worker in (county)

Description: This is the average income per worker in the trade and service sector in the county.

Discussion: Income per worker is calculated by dividing total income in the service and trade sectors by the total number of workers in those sectors.

Source: EIFS.

Service Income per Worker in (county)

Description: This is the average income per worker in the service sector in the county.

Discussion: Income per worker is calculated by dividing total income in the service sector by the total number of workers in the service sector.

Source: EIFS.

Construction Income per Worker in (county)

Description: This is the average income per worker in the construction sector in the county.

Discussion: Income per worker is calculated by dividing total income in the construction sector by the total number of workers in the sector.

Source: EIFS.

Distance from Installation to (county)

Description: This is the distance in road miles from the population centroid of the county to the installation or center of activity being analyzed.

Discussion: The above description also pertains to the county in which the installation or activity is located.

Source: Manual measurement on map.

Distance Between County and (other counties in boundary area)

Description: This is the distance in road miles from the population centroid of the county being analyzed and all other counties in the boundary area.

Discussion: The distance between the county and itself is defined as one-half the distance to its nearest neighboring county.

Sources: EIFS.

BEA Employ by Place of Work for (county)

Description: This is the total employment in the county.

Discussion: This parameter contains a time series starting in 1965.

Source: EIFS. The user may augment with data for the most recent years.

BEA Total Income by Place of Work for (county)

Description: This is the total personal income of persons working in the county.

Discussion: The parameter contains a time series starting in 1965.

Source: EIFS. The user may augment with data for the most recent years.

BEA Net Income by Place of Residence for (county)

Description: This is the total personal income of persons residing in the county.

Discussion: The parameter contains a time series starting in 1965.

Source: EIFS. The user may augment with data for the most recent years.

4.5 AFROI Outputs

The outputs of AFROI include a set of the inputs as well as tables of outputs that display the following: (1) geographic distribution of personnel and expenditures including those that were not allocated by the user to a specific county, (2) the total direct and induced change in sales, employment, and income by county, (3) the significance of the change in employment and income by county, and (4) the installation-specific multipliers by county. The program will also provide time series graphs of the employment and income for counties in which there will be significant change. The outputs are described in further depth in the following sections.

4.5.1 Place of Residence of Base Personnel

AFROI Table 1 identifies by county and category of personnel where each person assigned to the base resides. The table displays the information input by the user as well as the allocation of persons whose place of residence was not identified by the user (see Table 4.1).

4.5.2 Initial Distribution of Expenditures

AFROI Tables 2, 3, and 4 identify the expenditures by county for contracting (i.e., procurement), construction, and other, respectively. The tables indicate the county data provided by the user and the distribution of AF expenditures that were not allocated by the user to a specific county. These tables address direct AF expenditures, not secondary effects (see Tables 4.2, 4.3, and 4.4).

4.5.3 Change in Employment, Income, and Sales Volume

AFROI Tables 5 and 6 identify the direct and induced dollar change due to the action. Table 5 shows this change for sales volume, employment and personal income by place of work. Table 6 shows the change in income and employment, including working dependents by county of residence (see Tables 4.5 and 4.6).

Table 4.1

SAMPLE OUTPUT, PLACE OF RESIDENCE OF BASE PERSONNEL

**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

PLACE OF RESIDENCE OF BASE PERSONNEL

Area	Permanent Military	Military Trainees	Civil Service	NAF/BX	Working Dependents
Boundary Region	2295	4001	1229	329	575
champaign					
Input:	2200	4001	880	309	
Input + Allocated:	2200	4001	938	309	506
coles					
Input:	0	0	0	0	
Input + Allocated:	0	0	1	0	0
cumberland					
Input:	0	0	0	0	
Input + Allocated:	0	0	0	0	0
douglas					
Input:	0	0	0	0	
Input + Allocated:	0	0	1	0	0
edgar					
Input:	0	0	0	0	
Input + Allocated:	0	0	0	0	0
ford					
Input:	63	0	166	17	
Input + Allocated:	63	0	169	17	42
iroquois					
Input:	19	0	52	0	
Input + Allocated:	19	0	53	0	12
piatt					
Input:	0	0	0	0	
Input + Allocated:	0	0	1	0	0
vermilion					
Input:	13	0	59	3	
Input + Allocated:	13	0	65	3	14

Table 4.2

SAMPLE OUTPUT, INITIAL DISTRIBUTION OF BASE CONTRACTING EXPENDITURES

INITIAL DISTRIBUTION OF BASE CONTRACTING EXPENDITURES

Area	Services* ($1984)	Total* ($1984)
Boundary Region		
Input:	12670000	147084000
Input + Allocated:	12741000	147910000
champaign		
Input:	1158000	7396000
Input + Allocated:	10728000	123329000
coles		
Input:	0	0
Input + Allocated:	120000	1453000
cumberland		
Input:	0	0
Input + Allocated:	5000	60000
douglas		
Input:	0	0
Input + Allocated:	59000	719000
edgar		
Input:	0	0
Input + Allocated:	51000	618000
ford		
Input:	0	0
Input + Allocated:	478000	5796000
iroquois		
Input:	0	0
Input + Allocated:	157000	1905000
piatt		
Input:	0	0
Input + Allocated:	98000	1183000
vermilion		
Input:	6000	257000
Input + Allocated:	1045000	12847000

* Allocated portion includes 5.00% of total expenditures made on-base. This amount represents the proportion of BX sales to AF employees that are supplied by local vendors.

Table 4.3

SAMPLE OUTPUT, INITIAL DISTRIBUTION OF CONSTRUCTION EXPENDITURES

INITIAL DISTRIBUTION OF CONSTRUCTION EXPENDITURES

Area	MCP ($1984)	O&M ($1984)	NAF ($1984)	MFH ($1984)	Other ($1984)
Boundary Region					
Input:	26276000	0	0	0	0
Input + Allocated:	26276000	0	0	0	0
champaign					
Input:	17460000	0	0	0	0
Input + Allocated:	24439000	0	0	0	0
coles					
Input:	0	0	0	0	0
Input + Allocated:	87000	0	0	0	0
cumberland					
Input:	0	0	0	0	0
Input + Allocated:	4000	0	0	0	0
douglas					
Input:	0	0	0	0	0
Input + Allocated:	43000	0	0	0	0
edgar					
Input:	0	0	0	0	0
Input + Allocated:	37000	0	0	0	0
ford					
Input:	373000	0	0	0	0
Input + Allocated:	722000	0	0	0	0
iroquois					
Input:	0	0	0	0	0
Input + Allocated:	115000	0	0	0	0
piatt					
Input:	0	0	0	0	0
Input + Allocated:	71000	0	0	0	0
vermilion					
Input:	0	0	0	0	0
Input + Allocated:	758000	0	0	0	0

Table 4.4

SAMPLE OUTPUT, INITIAL DISTRIBUTION OF OTHER EXPENDITURES

**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

INITIAL DISTRIBUTION OF OTHER EXPENDITURES

Area	PL 81-874 ($1984)	CHAMPUS ($1984)	Supp/Coop ($1984)	Education ($1984)	Other ($1984)
Boundary Region					
Input:	3345000	0	0	0	0
Input + Allocated:	3345000	0	0	0	0
champaign					
Input:	3345000	0	0	0	0
Input + Allocated:	3345000	0	0	0	0
coles					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
cumberland					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
douglas					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
edgar					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
ford					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
iroquois					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
piatt					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0
vermilion					
Input:	0	0	0	0	0
Input + Allocated:	0	0	0	0	0

Table 4.5

SAMPLE OUTPUT, CHANGE IN SALES VOLUME, EMPLOYMENT AND INCOME BY PLACE OF WORK

**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

CHANGE IN SALES VOLUME, EMPLOYMENT AND INCOME BY PLACE OF WORK

County		Sales Volume ($1984)	Employment	Working Dependents	Income ($1984)
champaign					
	Direct:	-181982000	-10434		-164404000
	Induced:	-336309000	-3451		-46989000
	Total:	-518291000	-13885	-476	-211393000
coles					
	Direct:	-4558000	-51		-777000
	Induced:	-7830000	-86		-1045000
	Total:	-12388000	-137	-8	-1822000
cumberland					
	Direct:	-154000	-1		-10000
	Induced:	-137000	-1		-7000
	Total:	-291000	-1	-0	-17000
douglas					
	Direct:	-2121000	-8		-156000
	Induced:	-2183000	-9		-115000
	Total:	-4304000	-17	-5	-271000
edgar					
	Direct:	-1473000	-12		-210000
	Induced:	-1796000	-14		-185000
	Total:	-3270000	-26	-3	-395000
ford					
	Direct:	-4234000	-23		-396000
	Induced:	-5044000	-28		-323000
	Total:	-9278000	-51	-15	-719000
iroquois					
	Direct:	-3369000	-22		-400000
	Induced:	-4345000	-28		-367000
	Total:	-7714000	-50	-12	-767000
piatt					
	Direct:	-3200000	-26		-449000
	Induced:	-4036000	-32		-392000
	Total:	-7235000	-57	-8	-841000
vermilion					
	Direct:	-22896000	-267		-4408000
	Induced:	-41453000	-479		-5889000
	Total:	-64349000	-745	-48	-10297000

Table 4.6

SAMPLE OUTPUT, CHANGE IN EMPLOYMENT AND INCOME
BY PLACE OF RESIDENCE

**** AFKOI MODEL RESULTS FOR Chanute AFB Case Study ****

CHANGE IN EMPLOYMENT AND INCOME BY PLACE OF RESIDENCE

County		Employment	Working Dependents	Income ($1984)
champaign				
	Direct:	-9795		-151195000
	Induced:	-3230		-44227000
	Total:	-13025	-506	-195423000
coles				
	Direct:	-87		-1355000
	Induced:	-140		-1709000
	Total:	-227	-0	-3064000
cumberland				
	Direct:	-7		-121000
	Induced:	-6		-88000
	Total:	-14	-0	-209000
douglas				
	Direct:	-48		-890000
	Induced:	-47		-628000
	Total:	-95	-0	-1517000
edgar				
	Direct:	-27		-486000
	Induced:	-30		-396000
	Total:	-57	-0	-882000
ford				
	Direct:	-311		-6444000
	Induced:	-38		-450000
	Total:	-349	-42	-6895000
iroquois				
	Direct:	-116		-2443000
	Induced:	-49		-648000
	Total:	-165	-12	-3091000
piatt				
	Direct:	-53		-939000
	Induced:	-61		-757000
	Total:	-114	-0	-1696000
vermilion				
	Direct:	-412		-7395000
	Induced:	-525		-6498000
	Total:	-937	-14	-13894000

4.5.4 Significance of Impacts

AFROI Tables 7 and 8 identify the significance of the change by place of work and by place of residence respectively. Each table identifies the forecasted level of employment and personal income in the year the action occurs, the standard error of the forecast, the total impacts (from Tables 5 and 6), and the percentage change. Those counties where the total impacts (or change) exceed the standard deviation are highlighted with an "*." A county so identified on either table is recommended for inclusion in the ROI or AOI (see Tables 4.7 and 4.8).

4.5.5 Installation Specific Subregional Multiplier

AFROI Tables 9 and 10 provide multipliers for each of the counties in the boundary region. These describe the relationship between AF induced change and the resultant impacts in each county. The counties are listed in order of increasing distance from the base. Both income and employment multipliers are provided (see Tables 4.9 and 4.10).

4.5.6 Predicted Employment and Income

In addition to the aforementioned tables the program will provide plots of (1) predicted employment by place of work, (2) predicted income by place of work, and (3) predicted income by place of residence. Each plot displays in graphic form a timeline of (1) actual observation, (2) levels predicted by the program, (3) the standard deviation (both plus and minus) for the predicted levels, and (4) the estimated level of impact. Plots can be generated for each county where the impact is estimated to be significant (see Figures 4.3, 4.4, and 4.5).

Table 4.7

SAMPLE OUTPUT, SIGNIFICANCE OF PLACE OF WORK IMPACTS

**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

SIGNIFICANCE OF PLACE OF WORK IMPACTS

County	Forecast in 1986	Std Error of Forecast	Total Impacts	
champaign				
Employment:	89089	2319	-13885*	(15.6%)
Income ($1984):	1515212000	162997000	-211393000*	(14.0%)
coles				
Employment:	24264	1223	-137	(0.6%)
Income ($1984):	413002000	58794000	-1822000	(0.4%)
cumberland				
Employment:	4010	179	-1	(0.0%)
Income ($1984):	37598000	8119000	-17000	(0.0%)
douglas				
Employment:	8842	618	-17	(0.2%)
Income ($1984):	200417000	38791000	-271000	(0.1%)
edgar				
Employment:	8593	431	-26	(0.3%)
Income ($1984):	157204000	32958000	-395000	(0.3%)
ford				
Employment:	6787	349	-51	(0.8%)
Income ($1984):	110886000	32597000	-719000	(0.6%)
iroquois				
Employment:	13750	662	-50	(0.4%)
Income ($1984):	220896000	56692000	-767000	(0.3%)
piatt				
Employment:	5707	422	-57	(1.0%)
Income ($1984):	112801000	31624000	-841000	(0.7%)
vermilion				
Employment:	43154	2670	-745	(1.7%)
Income ($1984):	937899000	133243000	-10297000	(1.1%)

* Significant at the 90% confidence level.

Table 4.8

SAMPLE OUTPUT, SIGNIFICANCE OF PLACE OF RESIDENCE IMPACTS

**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

SIGNIFICANCE OF PLACE OF RESIDENCE IMPACTS

County	Forecast in 1986	Std Error of Forecast	Total Impacts	
champaign				
Income ($1984):	1338534000	156058000	-195423000*	(14.6%)
coles				
Income ($1984):	366619000	53053000	-3064000	(0.8%)
cumberland				
Income ($1984):	59913000	9668000	-209000	(0.3%)
douglas				
Income ($1984):	186040000	37243000	-1517000	(0.8%)
edgar				
Income ($1984):	163594000	33766000	-882000	(0.5%)
ford				
Income ($1984):	126751000	32025000	-6895000	(5.4%)
iroquois				
Income ($1984):	266645000	59625000	-3091000	(1.2%)
piatt				
Income ($1984):	156132000	32855000	-1696000	(1.1%)
vermilion				
Income ($1984):	846357000	115140000	-13894000	(1.6%)

* Significant at the 90% confidence level.

Not available: significance of place of residence employment impacts.

Table 4.9

SAMPLE OUTPUT, INSTALLATION-SPECIFIC MULTIPLIERS
FOR PLACE OF WORK IMPACTS

**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

INSTALLATION-SPECIFIC MULTIPLIERS FOR PLACE OF WORK IMPACTS

County	Distance (Miles)	Impact Multipliers Employment	Income
champaign	13.9	1.7679	0.2941
ford	17.4	0.0065	0.0010
vermilion	31.0	0.0949	0.0143
piatt	34.8	0.0073	0.0012
iroquois	38.4	0.0064	0.0011
douglas	41.3	0.0022	0.0004
edgar	56.5	0.0033	0.0005
coles	62.4	0.0175	0.0025
cumberland	78.5	0.0001	0.0000
Region		1.9061	0.3152

Table 4.10

SAMPLE OUTPUT, INSTALLATION-SPECIFIC MULTIPLIERS FOR
PLACE OF RESIDENCE IMPACTS

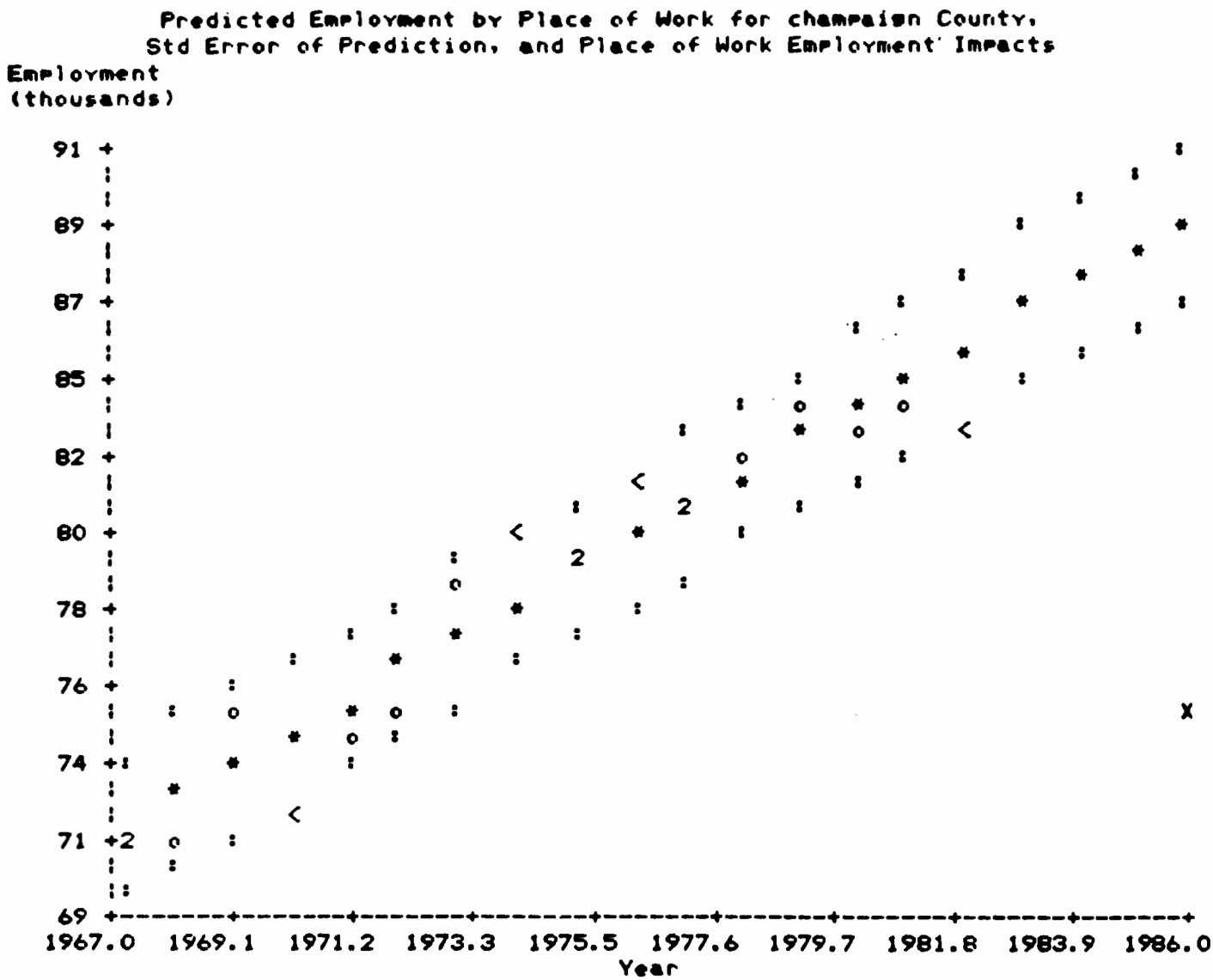
**** AFROI MODEL RESULTS FOR Chanute AFB Case Study ****

INSTALLATION-SPECIFIC MULTIPLIERS FOR PLACE OF RESIDENCE IMPACTS

County	Distance (Miles)	Impact Multipliers Employment	Income
champaign	13.9	1.6584	0.2719
ford	17.4	0.0444	0.0096
vermilion	31.0	0.1193	0.0193
piatt	34.8	0.0145	0.0024
iroquois	38.4	0.0211	0.0043
douglas	41.3	0.0121	0.0021
edgar	56.5	0.0072	0.0012
coles	62.4	0.0289	0.0043
cumberland	78.5	0.0018	0.0003
Region		1.9077	0.3154

Figure 4.3

SAMPLE OUTPUT, PLACE OF WORK EMPLOYMENT IMPACTS



Key: * = Predicted Employment
o = Observed Employment
2 = Both Observed and Predicted
: = Std error of prediction (90% confidence level)
< = Observed value less than std error
> = Observed value greater than std error
X = Employment impacts = -14391

intercept	=	-1774.015	std err =	153.2487
coefficient	=	0.938	std err =	0.0776
R-squared	=	0.913	dof =	14

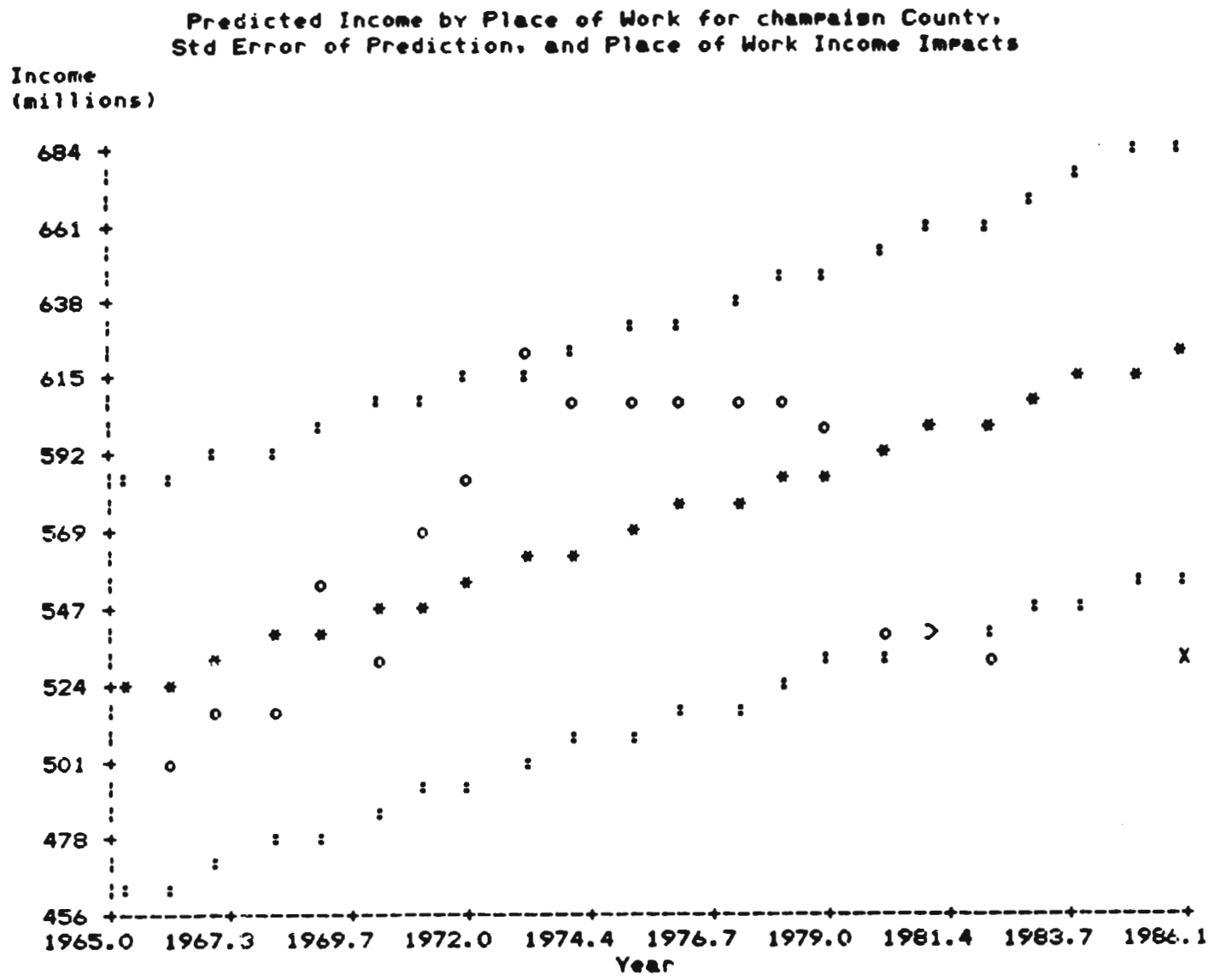
Figure 4.3 (concluded)

Summary of Input Data

year	observed	predicted	std err
1967	70956	71265	2133
1968	71043	72203	2097
1969	74890	73141	2066
1970	71788	74079	2039
1971	74043	75018	2017
1972	74842	75956	2001
1973	78482	76894	1990
1974	79594	77832	1985
1975	79361	78770	1985
1976	81348	79708	1990
1977	80842	80646	2001
1978	82150	81584	2017
1979	83874	82522	2039
1980	82672	83461	2066
1981	83810	84399	2097
1982	83120	85337	2133
1983	0	86275	2173
1984	0	87213	2218
1985	0	88151	2267
1986	0	89089	2319

Figure 4.4

SAMPLE OUTPUT, PLACE OF WORK INCOME IMPACTS



Key: * = Predicted Income
o = Observed Income
2 = Both Observed and Predicted
: = Std error of prediction (90% confidence level)
< = Observed value less than std error
> = Observed value greater than std error
X = Income impacts = -86107205

intercept	=	-8758.975	std err	=	3792.7561
coefficient	=	4.721	std err	=	1.9218
R-squared	=	0.274	dof	=	16

Figure 4.4 (concluded)

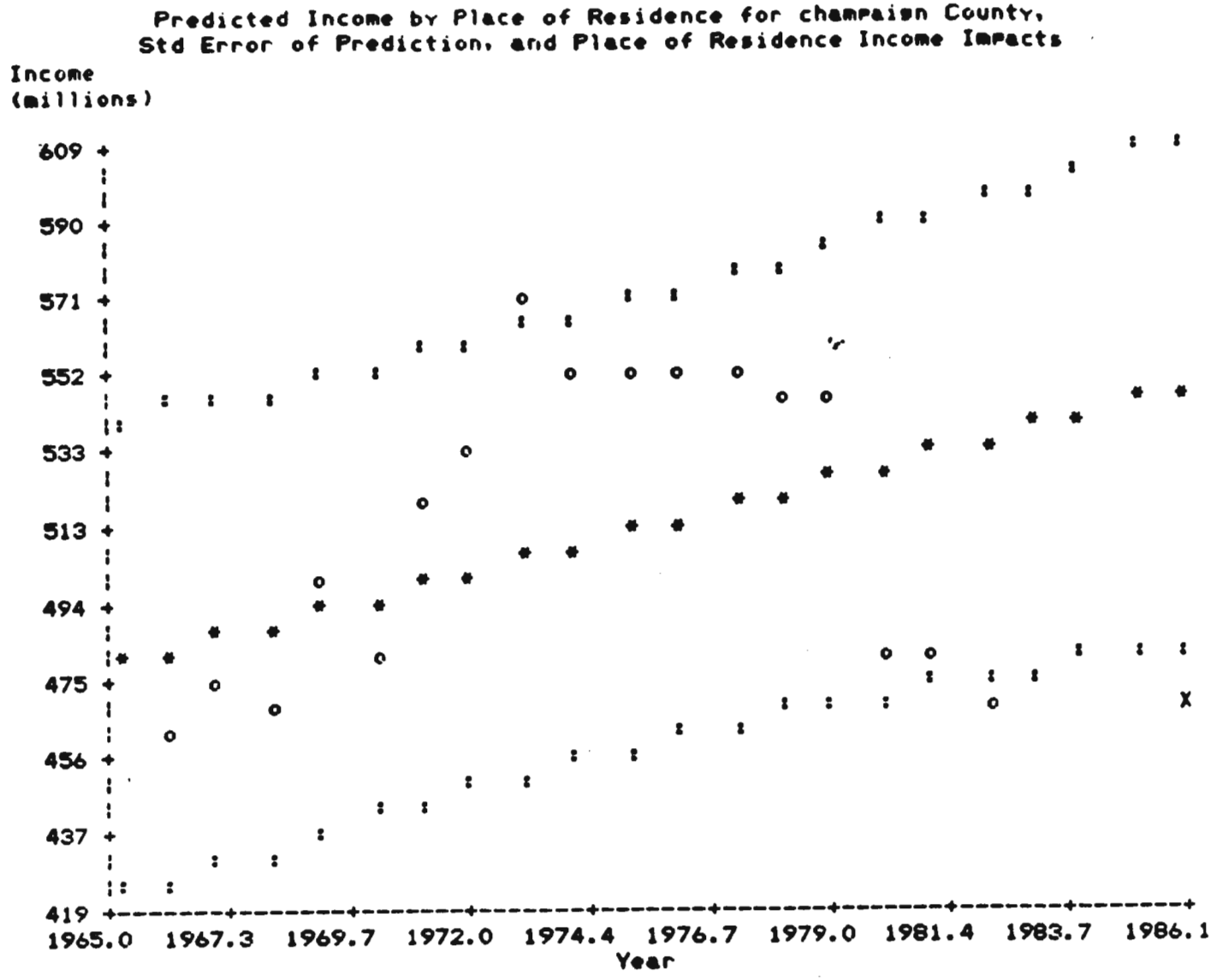
Summary of Input Data

Year	observed	predicted	std err
1965	445566349	518050457	62076917
1966	499951041	522771589	61220150
1967	515008801	527492722	60460521
1968	512349778	532213855	59801730
1969	547529690	536934987	59247143
1970	528021578	541656120	58799707
1971	566909118	546377252	58461883
1972	581335000	551098385	58235578
1973	622008492	555819518	58122095
1974	605089938	560540650	58122095
1975	604768468	565261783	58235578
1976	603249122	569982915	58461883
1977	604225698	574704048	58799707
1978	602880716	579425181	59247143
1979	599347161	584146313	59801730
1980	538762075	588867446	60460521
1981	538908452	593588578	61220150
1982	531330033	598309711	62076917
1983	0	603030844	63026860
1984	0	607751976	64065834
1985	0	612473109	65189583
1986	0	617194242	66393803

All monetary values are stated in 1972 dollar equivalents.

Figure 4.5

SAMPLE OUTPUT, PLACE OF RESIDENCE INCOME IMPACTS



Key: * = Predicted Income
o = Observed Income
2 = Both Observed and Predicted
: = Std error of prediction (90% confidence level)
< = Observed value less than std error
> = Observed value greater than std error
X = Income impacts = -79601955

intercept	=	-5803.601	std err	=	3631.2975
coefficient	=	3.197	std err	=	1.8400
R-squared	=	0.159	dof	=	16

Figure 4.5 (concluded

Summary of Input Data

year	observed	predicted	std err
1965	411672447	478095262	59434287
1966	460737122	481292054	58613993
1967	472843386	484488846	57886701
1968	467740402	487685639	57255955
1969	498493159	490882431	56724977
1970	479750024	494079223	56296588
1971	515442173	497276015	55973145
1972	527546000	500472807	55756474
1973	565693048	503669599	55647822
1974	548095872	506866392	55647822
1975	549233113	510063184	55756474
1976	545759772	513259976	55973145
1977	547523833	516456768	56296588
1978	543500983	519653560	56724977
1979	540472088	522850352	57255955
1980	479679880	526047144	57886701
1981	475586313	529243937	58613993
1982	465054302	532440729	59434287
1983	0	535637521	60343790
1984	0	538834313	61338535
1985	0	542031105	62414446
1986	0	545227897	63567401

All monetary values are stated in 1972 dollar equivalents.

5. EXAMPLE APPLICATIONS

In the following sections AFROI is applied to identify (1) the ROI for Robins AFB and (2) the AOI for an increase in activity at Robins AFB. Each follows the steps described in Section 4.3.

Robins AFB was selected for the example cases in part because of the large number of counties influenced by the base. For a more typical base, the boundary region, ROI and AOI will contain considerably fewer counties.

5.1 Identify ROI

5.1.1 Step 1, Collect Data

First the data required for the tables presented in Appendix B were collected from various on-base sources. Refer to Tables 5.1 through 5.6. These tables contain most of the information needed to fill out the input questionnaire (Table 5.7). The inputs are described below.

Regional Inputs

Project: In this case the task is to define the ROI.

County where base is located: This information was obtained from a map.

Year of completion of action: The year 1984 was selected because most of field data is for 1984, therefore, the results of the run will be the 1984 ROI.

Regional multipliers: The employment and income multipliers were obtained from EIFS and automatically entered into AFROI (see Section 4.3.3).

Total number of affected personnel: Data from Table 5-1.

Number of affected personnel by class: Data from Table 5-1.

Average wages of affected personnel: Data from Table 5-1.

Base Contracting (Services): Total services from Table 5.5.

Base Contracting (Total): In this case it is assumed that the counties for which data was available (see Table 5.5) will be in the boundary region and that the "Other Georgia" counties will not. Thus total contracting should equal the sum of total services ($20.6 million) and the county total of all other ($156.5 million).

Table 5.1

PAYROLL FOR FY84

Personnel Classification	Number	Annual Payroll ($000)[b] Total	Average
Military			
Permanent Party	3,813	86,000	22.6
Trainees	0	0	0
Other	0	0	0
Total	3,813	86,000	0
Civilian			
Civil Service	15,365	434,300	28.3
Nonappropriated Fund) Base Exchange)	603	4,300	7.1
Total	15,968	438,600	
Total Military and Civilian	19,781	524,600	
Other			
On Base Contractors			
Service	750	12,600	16.8
Construction	1,261	17,400	13.8
On Base Private Business[a]	134	2,100	15.7

[a] Includes credit union, bank, post office, ticket office, and resident centers.

[b] Total salaries paid in FY84.

Source: Economic Impact of Robins Air Force Base FY 1984, Cost and Analysis Office (30 December 1984)

Table 5.2

PLACE OF RESIDENCE OF PERSONNEL
Robins AFB

County	Military				Civilian			Grand Total	
	Permanent Party	Trainee	Other	Total	Civil Service	NAF & BX	Total	No.	%
Houston	3,735				8,458	521	8,979	12,714	64.3
On-Base								(2,274)	
Off-Base								(1,539)	
Bibb	37				3,661	46	3,706	3,743	18.9
Peach	17				824	21	845	862	4.4
Bleckley	7				460	4	464	471	2.4
Dodge	1				328		328	329	1.7
Pulaski	3				260	2	262	265	1.3
Laurens	1				222	2	224	225	1.1
Wilcox	3				156		156	159	0.8
Twiggs	2				121	2	123	125	0.6
Dooly					105	4	109	109	0.6
Monroe	3				87		87	90	0.5
Jones					86		86	86	0.4
Macon	1				77		77	78	0.4
Crawford					64	1	65	65	0.3
Telfair					58		58	58	0.3
Upson					50		50	50	0.3
Wilkinson	1				41		41	42	0.2
Baldwin	1				32		32	33	0.2
Putnam	1				31		31	32	0.2
Jasper					27		27	27	0.1
Lamar					22		22	22	0.1
Butts					19		19	19	0.1
Johnson					15		15	15	0.1
Crisp					13		13	13	0.1
Other					75	1	76	76	0.4
Total	3,813				15,365	603	15,968	19,781	99.8

Source: J. L. Smith, Chief, Management Analysis, Robins AFB

Table 5.3

CONSTRUCTION EXPENDITURE BY LOCATION OF CONTRACTOR, HOME OFFICE
($000)

Geographic Area	MCP	NAF*	O&M	MFH	Total	%
Georgia counties						
Ben Hill	2,884	N/A	0		2,884	5.4
Bibb	0		2,128		2,128	4.0
Bleckley	1,284		0	99	1,383	2.6
Chattahoochie	8,874		477		9,351	17.6
Cobb	2,961		0		2,961	5.6
Columbia	0		148		148	0.3
Doughtery	0		140		140	0.3
Fulton	0		1,803	224	2,027	3.8
Houston	1,882		5,397	590	7,869	14.8
Lowndes	0		316	40	356	0.7
Taylor	0		243		243	0.5
Total	17,885		11,605		29,490	55.4
Outside Georgia	15,603		7,635	536	23,774	44.6
Total	33,488		18,287	1,489	53,264	100.0

Note: a. This table includes only those contracts that were active on May 1, 1985. These are projects that are either underway or awarded and yet to commence. Some of these projects are multiyear. b. Those portions of the PavePaws radar system that are being constructed under the auspices of the Electronics System Division are not included. The bulk of these expenditures are for radar systems to be provided by out of state contractors.

*NAF included in MCP.

Source: Robins AFB, "Contract Management Report," (1 April and 1 May, 1985)

Table 5.4

CONSTRUCTION EXPENDITURES BY YEAR ($000)

Fiscal year	MCP	NAF	MFH	O&M	Other	Total
81	14,400	600				
82	5,000	0				
83	2,900	100				
84	11,500	500				
85	29,000	900				
Total	62,800	2,100	NA	NA	NA	NA
Average annual	12,500	420	NA	NA	NA	NA

Sources: Wylie Avant, NAF Programming, Robins AFB (Jan 85); Ron Willis, MCP Programming, Robins AFB (Jan 85)

Table 5.5

PROCUREMENT BY LOCATION OF VENDOR FY84 ($000)

Location	Services	All Other	Total	%
Houston	3,200	15,800	19,000	0.6
Bibb	3,200	15,800	19,000	0.6
Bleckley	1,284	0	1,284	--
Fulton	0	124,900	124,900	4.2
County total	7,684	156,500	164,184	
Other Georgia	0	24,500	24,500	0.8
Other U.S.	12,916	2,798,400	2,811,316	93.7
Total	20,600	2,979,400	3,000,000	99.9
%	0.7	99.3	100	

Sources: Robins AFB, "Contract Management Report" (1 May 1985); M. Merritt, Plans and Programs, Robins AFB

Table 5.6

MISCELLANEOUS EXPENDITURES FOR FY84 ($000)

Category	Houston	Bibb	Peach	Total
Payments to School Districts Total	713	23	7	743
Health Care				
CHAMPUS				2,600
Sup/Coop Care				155
Total				
Tuition assistance				NA
Total				3,498

Sources: Cost and Management Analysis, Robins AFB, Economic Impact of Robins AFB (20 December 1984); Betty Clark, Cost and Management, Robins AFB

Table 5.7

INPUT QUESTIONNAIRE, ROBINS AFB ROI

********** REGIONAL INPUTS **********

Project: ROBINS AFB ROI

County where base is located: HOUSTON

Year of completion of action: 1984

Regional employment multiplier: _____

Regional income multiplier: _____

Total number of affected personnel: 12781

# of affected personnel by class
- Permanent military: 3813
- Military trainees : 6
- Civil Service : 7526
- NAF/BX : 603

Average wages of affected personnel
- Permanent military: $ 22,600
- Military trainees : $ 0
- Civil Service : $ 28,300
- NAF/BX : $ 7,100

Dollar amount change in regional AF expenditures

Base Contracting (Services)	: $	20,600,000
Base Contracting (Total)	: $	177,100,000
Military Construction Program (MCP)	: $	12,500,000
O&M Contract Construction	: $	18,287,000
Non-Appropriated Fund (NAF) Construction	: $	2,100,000
Military Family Housing (MFH) Construction	: $	1,489,000
Other Construction	: $	0
PL 81-874 Public School Program	: $	143,000
CHAMPUS	: $	2,600,000
Supplemental/Cooperative Care	: $	155,000
Education Programs	: $	0
All Other Programs (except BX)	: $	0

********** SYSTEM PARAMETERS **********

Working dependents full time equivalency factor: _____

Fraction of working dependents
- Permanent military: 0.226
- Military trainees : 0
- Civil Service : 0
- NAF/BX : 0

Fraction of AF employees living on-base
- Permanent military: _____
- Military trainees : _____
- Civil Service : _____
- NAF/BX : _____

Table 5.7 (continued)

Fraction of income spent in boundary region (on and off-base)
  Permanent military: ________
  Military trainees : ________
  Civil Service   : ________
  NAF/BX   : ________

Fraction of income spent off-base by persons living off-base
  Permanent military: ________
  Military trainees : ________
  Civil Service   : ________
  NAF/BX   : ________

Fraction of income spent off-base by persons living on-base
  Permanent military: ________
  Military trainees : ________
  Civil Service   : ________
  NAF/BX   : ________

Fraction of construction expenditures for
  materials: ________
  labor   : ________

Fraction of contracted service expenditures for
  materials: ________
  labor   : ________

Fraction of BX sales from local suppliers: ________

Gravity model exponent: ________

Forecast confidence level: __%

CPI price deflators
  Base year: _____
  Inputs   : _____
  Outputs : _____

********** COUNTY INPUTS for >> Houston << **********

Population: ______

Employment multiplier: 1.5822

Income multiplier: 1.4419

Number of affected personnel by class
  Permanent military: 5782
  Military trainees : 0
  Civil Service   : 8452
  NAF/BX   : 521

Change in expenditures
  Base Contracting (Services) : $ 2,200,000
  Base Contracting (Total) : $ 12,000,000
  Military Construction Program (MCP) : $ 102,000
  O&M Contract Construction : $ 5,327,000
  Non-Appropriated Fund (NAF) Construction : $ 24,000
  Military Family Housing (MFH) Construction: $ 520,000
  Other Construction : $ 0
  PL81-874 Public School Program : $ 713,000
  CHAMPUS : $ 1,002,000
  Supplemental/Cooperative Care : $ 120,000
  Education Programs : $ 0
  All Other Programs (except BX) : $ 0

Table 5.7 (concluded)

Trade and service employment: _____

Trade and service sales per worker: $ _____

Trade and service income per worker: $ _____

Service income per worker: $ _____

Construction income per worker: $ _____

Distance from installation: 9 MILES

Distance between _____ and

_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____

BEA employment by place of work

_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____
_____: _____

BEA total income by place of work

_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____

BEA net income by place of residence

_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____
_____: $ _____

Military Construction Program (MCP): In this example, we want to identify a typical ROI, not one influenced by the annual variations in spending. Therefore, we have selected the average level of MCP spending (12.5 million) from Table 5.4, rather than the actual amount spent in FY84 ($11.5 million) or amount committed for FY85 ($29.0 million). (MCP construction is also recorded in Table 5.3 which shows the geographic distribution of all contracts active on 1 May 1985. As a snapshot, it does not necessarily reflect the actual amount spent during a year.)

O&M Construction: The average levels of O&M spending were not available (see Table 5.4), therefore, the actual spending in FY84 was used (see Table 5.3).

NAF Construction: As with MCP, the average annual expenditure is used (see Table 5.4).

Military Family Housing (MFH) Construction: The average levels of spending were not available (see Table 5-4). Therefore, the actual FY84 expenditures were used (see Table 5.3).

Other Construction: In 1984 there were no construction activities that would not have been included in the previous categories. However, in 1985 construction for the PAVE-PAWS radar commenced, and the non-MCP portion of this program would have been included under "other."

PL 81-874 Public School Program, Health Care, and Education Program: The total expenditures in these categories are presented in Table 5.5. The amount of tuition assistance was not available, and because the absolute amount is relatively small the AFROI value was set at 0. There were no known "other programs."

System Parameters

For this example, the AFROI default values for all system parameters (other than those described below) were accepted.

Fraction of AF Employees Living On-Base: These factors are calculated by simply dividing the number of personnel in each category living on-base by the total number of persons in that category. A categorical breakdown was not available at Robins, therefore it was assumed that all personnel living on-base (2,274, Table 5.2) are military. Thus, the military factor is 0.596 (2,774/3,813). It follows from this assumption that no civilians live on-base, consequently the defaults for civil service and NAF/BX were overridden and set to 0.

County Inputs

County inputs were developed for each county in the boundary region. Before this can be accomplished the boundary region (and thus the counties of interest) should be established (Step 2) and the EIFS

data should be transferred (Step 3). For the sake of brevity, only the inputs for Houston County are discussed.

Population: The 1980 population automatically transferred from EIFS was accepted.

Multipliers: The employment and income multipliers were obtained from EIFS for manual entry into AFROI as part of Step 3.

Number of Affected Personnel by Class: Data from Table 5.2.

Base Contracting (Services and Total): Data from Table 5.5.

MCP Construction: To determine the amount of MCP construction that should be allocated to Houston County, determine the proportion of MCP construction presently underway in Houston County (Table 5.3; $1,882 million/33,488 = 5.6%) and apply that proportion to the total annual average (5.6% x $12.5 million) to yield $702,000.

O&M Construction: Because the total amount of O&M construction above was based on the actual FY84 expenditure, the amount occurring in Houston County can be read directly from Table 5.3.

NAF Construction: NAF is included with MCP construction in Table 5.3, therefore, the factor derived for MCP should be applied to the average annual total (5.6% x $420,000) to obtain the average amount of spending in Houston County.

MFH Construction: The amount of MFH construction expenditures in Houston County should be determined in the same manner as MCP construction. However, due to the lack of data for Table 5.4, the amount of MFH construction can be obtained directly from Table 5.3.

PL 81-874 Public School Program: Data from Table 5.6

Health Care: CHAMPUS and Supplemental and Cooperative Care expenditures are not disaggregated by county. Such expenditures usually occur in the "catchment area" which includes all areas within 50 miles of the base. For the purposes of this example, these expenditures will be allocated by the AFROI gravity model.

Distance from Installation: This is the distance between Robins and the centroid of population in Houston County which is estimated to be the centroid of Warner Robins.

Distance Between Houston County and Houston County: All other intercounty distances were provided by EIFS in Step 3, and the shortest distance appearing in the list was halved to obtain the value.

Other Inputs: All other system parameters were obtained from EIFS.

5.1.2 Step 2, Identify Boundary Region

The boundary region for Robins AFB was determined by identifying the BEA region near the base that receives the bulk of the direct expenditures. Tables 5.2, 5.3, 5.5, and 5.6 list the counties. These were compared with the counties in BEA regions near Robins and it was found that all counties of interest were in the Macon, Georgia BEA region, except Fulton County (Table 5.5) which is in the Atlanta BEA Region. Because of the large expenditure ($124 million) in Fulton County, it warrants inclusion and because of the distance from Robins and the secondary effects of such expenditures, it was decided that the entire Atlanta BEA Region should be included in the boundary region.

5.1.3 Step 3, Enter Data

EIFS was accessed in the manner described in Section 4.3.3, and the boundary region and county multipliers were transcribed on the data questionnaire and the balance of the data was automatically transferred via Profile 80. Following this, the data collected in Step 1 was entered.

5.1.4 Step 4, Confirm AFROI System Parameters

With the use of Option 6, the system parameters were reviewed and no changes were made.

5.1.5 Step 5, Run AFROI

The results of the AFROI run are displayed in Tables 5.8 and 5.9 and the ROI is depicted in Figure 5.1.

5.1.6 Results

Based on impacts by place of work (see Table 5.8) the counties recommended for inclusion in the ROI are as follows: Bibb, Houston, Peach, and Pulaski. Based on impacts by place of residence (see Table 5.9) the recommended ROI counties are as follows: Bibb, Houston, Peach, Bleckley, Jones, and Twiggs. The percentage of total county employment and personal income attributable to Robins AFB for these counties is summarized in Table 5.10.

The results of AFROI demonstrate that the ROI should be comprised of these seven counties. However, there are qualitative factors that suggest the possible inclusion of additional counties. For example, the percent of personal income attributable to Robins AFB in Dodge (12.6%) and Wilcox (13.0%) counties exceeds that of Jones County (9.3%) which is in the ROI. Furthermore, the population of AF personnel in Dodge, Laurens, and Wilcox counties exceeds the AF population in Twiggs County which is also in the ROI. The inclusion of additional counties is a subjective decision, and will depend in part on the nature of the analysis being carried out.

**** AFROI MODEL RESULTS FOR Robins AFB ROI ****

Table 5.8

SIGNIFICANCE OF PLACE OF WORK IMPACTS

County	Forecast in 1986	Std Error of Forecast	Total Impacts	
baldwin				
Employment:	18484	708	-138	(0.7%)
Income ($1984):	283633000	13360000	-1777000	(0.6%)
banks				
Employment:	2781	124	-1	(0.0%)
Income ($1984):	35720000	5181000	-7000	(0.0%)
barrow				
Employment:	10185	381	-8	(0.1%)
Income ($1984):	137073000	9481000	-120000	(0.1%)
bartow				
Employment:	20793	1233	-8	(0.0%)
Income ($1984):	340991000	38968000	-130000	(0.0%)
bibb				
Employment:	78618	920	-10243*	(13.0%)
Income ($1984):	1369096000	72641000	-128649000*	(9.4%)
bleckley				
Employment:	4278	291	-225	(5.3%)
Income ($1984):	41278000	7867000	-2305000	(5.6%)
butts				
Employment:	4252	201	-6	(0.1%)
Income ($1984):	54465000	4813000	-90000	(0.2%)
carroll				
Employment:	28972	700	-17	(0.1%)
Income ($1984):	435058000	32062000	-276000	(0.1%)
cherokee				
Employment:	12442	746	-2	(0.0%)
Income ($1984):	150151000	11997000	-43000	(0.0%)
clarke				
Employment:	54000	2031	-140	(0.3%)
Income ($1984):	902275000	70988000	-1790000	(0.2%)
clayton				
Employment:	73966	3373	-206	(0.3%)
Income ($1984):	1506366000	96563000	-3067000	(0.2%)

Table 5.8 (continued)

cobb				
Employment:	126522	11150	-207	(0.2%)
Income ($1984):	2221989000	211689000	-3671000	(0.2%)
coweta				
Employment:	15513	873	-56	(0.4%)
Income ($1984):	254978000	29026000	-675000	(0.3%)
crawford				
Employment:	1596	93	-44	(2.8%)
Income ($1984):	14618000	2385000	-415000	(2.8%)
crisp				
Employment:	9582	577	-175	(1.8%)
Income ($1984):	123784000	19081000	-1876000	(1.5%)
dawson				
Employment:	1828	242	-0	(0.0%)
Income ($1984):	16502000	4816000	-4000	(0.0%)
de kalb				
Employment:	268245	14878	-780	(0.3%)
Income ($1984):	8102603000	372449000	-16304000	(0.2%)
dodge				
Employment:	6811	241	-172	(2.5%)
Income ($1984):	70040000	10577000	-1852000	(2.6%)
dooly				
Employment:	4761	228	-117	(2.5%)
Income ($1984):	54732000	16652000	-1255000	(2.3%)
douglas				
Employment:	14066	472	-11	(0.1%)
Income ($1984):	193833000	11893000	-207000	(0.1%)
elbert				
Employment:	9141	514	-7	(0.1%)
Income ($1984):	128548000	9330000	-103000	(0.1%)
fannin				
Employment:	3664	281	-1	(0.0%)
Income ($1984):	41794000	5230000	-12000	(0.0%)
fayette				
Employment:	8790	609	-8	(0.1%)
Income ($1984):	132450000	9429000	-155000	(0.1%)
floyd				
Employment:	40552	2303	-36	(0.1%)
Income ($1984):	698287000	80062000	-532000	(0.1%)
forsyth				
Employment:	8544	667	-3	(0.0%)
Income ($1984):	120825000	10517000	-62000	(0.1%)
franklin				
Employment:	6350	225	-4	(0.1%)
Income ($1984):	77816000	8804000	-58000	(0.1%)
fulton				
Employment:	600751	30298	-5864	(1.0%)
Income ($1984):	19871148000	940347000	-113471000	(0.6%)
gilmer				
Employment:	5306	209	-2	(0.0%)
Income ($1984):	68917000	7583000	-25000	(0.0%)

Table 5.8 (continued)

gordon				
Employment:	15063	1043	-3	(0.0%)
Income ($1984):	225156000	29050000	-57000	(0.0%)
greene				
Employment:	4656	249	-15	(0.3%)
Income ($1984):	54733000	4865000	-184000	(0.3%)
gwinnett				
Employment:	69952	6481	-21	(0.0%)
Income ($1984):	1230615000	107710000	-450000	(0.0%)
habersham				
Employment:	12365	546	-5	(0.0%)
Income ($1984):	176743000	14935000	-78000	(0.0%)
hall				
Employment:	41570	1718	-51	(0.1%)
Income ($1984):	641609000	37725000	-806000	(0.1%)
hancock				
Employment:	1995	210	-24	(1.2%)
Income ($1984):	23534000	2103000	-184000	(0.8%)
haralson				
Employment:	8570	692	-5	(0.1%)
Income ($1984):	118624000	13918000	-66000	(0.1%)
hart				
Employment:	7569	286	-3	(0.0%)
Income ($1984):	108092000	9717000	-31000	(0.0%)
heard				
Employment:	3182	1176	-0	(0.0%)
Income ($1984):	56652000	28172000	-1000	(0.0%)
henry				
Employment:	11429	422	-36	(0.3%)
Income ($1984):	188470000	16108000	-430000	(0.2%)
houston				
Employment:	38420	1366	-28342*	(73.8%)
Income ($1984):	859994000	121959000	-630965000*	(73.4%)
jackson				
Employment:	9117	166	-8	(0.1%)
Income ($1984):	119176000	10634000	-104000	(0.1%)
jasper				
Employment:	3607	235	-27	(0.7%)
Income ($1984):	58572000	7001000	-222000	(0.4%)
johnson				
Employment:	3510	218	-12	(0.3%)
Income ($1984):	37373000	5408000	-124000	(0.3%)
jones				
Employment:	2815	162	-8	(0.3%)
Income ($1984):	37591000	4984000	-134000	(0.4%)
lamar				
Employment:	4341	182	-50	(1.2%)
Income ($1984):	56649000	6886000	-554000	(1.0%)
laurens				
Employment:	20637	1059	-374	(1.8%)
Income ($1984):	286430000	30604000	-4525000	(1.6%)

Table 5.8 (continued)

lumpkin				
Employment:	4359	191	-1	(0.0%)
Income ($1984):	47894000	6316000	-15000	(0.0%)
macon				
Employment:	5740	602	-191	(3.3%)
Income ($1984):	76544000	14916000	-1716000	(2.2%)
madison				
Employment:	3885	152	-1	(0.0%)
Income ($1984):	38865000	4435000	-16000	(0.0%)
monroe				
Employment:	7947	623	-180	(2.3%)
Income ($1984):	126149000	15961000	-2075000	(1.6%)
morgan				
Employment:	5607	306	-12	(0.2%)
Income ($1984):	73885000	5621000	-150000	(0.2%)
newton				
Employment:	11699	521	-36	(0.3%)
Income ($1984):	179454000	13460000	-564000	(0.3%)
oconee				
Employment:	2897	211	-4	(0.1%)
Income ($1984):	32215000	3181000	-54000	(0.2%)
oglethorpe				
Employment:	2056	58	-8	(0.4%)
Income ($1984):	23970000	3871000	-65000	(0.3%)
paulding				
Employment:	5391	325	-3	(0.1%)
Income ($1984):	68391000	6109000	-56000	(0.1%)
peach				
Employment:	9180	422	-876*	(9.5%)
Income ($1984):	133075000	7806000	-9440000*	(7.1%)
pickens				
Employment:	5178	221	-1	(0.0%)
Income ($1984):	68306000	5298000	-19000	(0.0%)
pike				
Employment:	2222	137	-1	(0.0%)
Income ($1984):	21333000	1716000	-10000	(0.0%)
polk				
Employment:	12333	944	-11	(0.1%)
Income ($1984):	183330000	22595000	-140000	(0.1%)
pulaski				
Employment:	3335	68	-255*	(7.6%)
Income ($1984):	38039000	9443000	-2616000	(6.9%)
putnam				
Employment:	5190	449	-22	(0.4%)
Income ($1984):	96477000	10152000	-266000	(0.3%)
rabun				
Employment:	4291	261	-3	(0.1%)
Income ($1984):	49933000	5510000	-32000	(0.1%)
rockdale				
Employment:	16343	784	-5	(0.0%)
Income ($1984):	266414000	12475000	-89000	(0.0%)

Table 5.8 (concluded)

spalding				
Employment:	21150	525	-142	(0.7%)
Income ($1984):	296259000	17273000	-1851000	(0.6%)
stephens				
Employment:	11137	816	-7	(0.1%)
Income ($1984):	166484000	21951000	-93000	(0.1%)
taylor				
Employment:	3222	210	-40	(1.3%)
Income ($1984):	35537000	5921000	-446000	(1.3%)
telfair				
Employment:	5721	339	-77	(1.3%)
Income ($1984):	78953000	8218000	-744000	(0.9%)
towns				
Employment:	1630	99	-1	(0.0%)
Income ($1984):	19139000	2006000	-14000	(0.1%)
treutlen				
Employment:	2112	92	-9	(0.4%)
Income ($1984):	18910000	3647000	-82000	(0.4%)
twiggs				
Employment:	2899	160	-4	(0.2%)
Income ($1984):	53260000	6579000	-75000	(0.1%)
union				
Employment:	3335	207	-0	(0.0%)
Income ($1984):	33954000	4213000	-6000	(0.0%)
upson				
Employment:	12407	329	-98	(0.8%)
Income ($1984):	166462000	15761000	-1224000	(0.7%)
walton				
Employment:	11807	545	-16	(0.1%)
Income ($1984):	156505000	13829000	-238000	(0.2%)
washington				
Employment:	9366	256	-66	(0.7%)
Income ($1984):	142165000	11241000	-661000	(0.5%)
wheeler				
Employment:	1539	127	-11	(0.7%)
Income ($1984):	19491000	4737000	-92000	(0.5%)
white				
Employment:	3998	172	-1	(0.0%)
Income ($1984):	45422000	6201000	-15000	(0.0%)
wilcox				
Employment:	2147	55	-36	(1.7%)
Income ($1984):	24155000	7241000	-363000	(1.5%)
wilkinson				
Employment:	4166	262	-70	(1.7%)
Income ($1984):	73772000	4826000	-584000	(0.8%)

* Significant at the 90% confidence level.

**** AFROI MODEL RESULTS FOR Robins AFB ROI ****

Table 5.9

SIGNIFICANCE OF PLACE OF RESIDENCE IMPACTS

County	Forecast in 1986	Std Error of Forecast	Total Impacts	
baldwin				
Income ($1984):	239047000	11079000	-4415000	(1.8%)
banks				
Income ($1984):	50111000	4906000	-89000	(0.2%)
barrow				
Income ($1984):	166124000	11496000	-424000	(0.3%)
bartow				
Income ($1984):	336583000	29562000	-526000	(0.2%)
bibb				
Income ($1984):	1278574000	75713000	-202707000*	(15.9%)
bleckley				
Income ($1984):	65278000	9768000	-15871000*	(24.3%)
butts				
Income ($1984):	84562000	5969000	-1498000	(1.8%)
carroll				
Income ($1984):	429236000	30741000	-1063000	(0.2%)
cherokee				
Income ($1984):	359507000	16254000	-1085000	(0.3%)
clarke				
Income ($1984):	625481000	44915000	-2431000	(0.4%)
clayton				
Income ($1984):	1927811000	94248000	-8646000	(0.4%)
cobb				
Income ($1984):	3343197000	132086000	-18476000	(0.6%)
coweta				
Income ($1984):	341309000	20313000	-1100000	(0.3%)
crawford				
Income ($1984):	32637000	3043000	-2905000	(8.9%)
crisp				
Income ($1984):	117015000	17016000	-2253000	(1.9%)
dawson				
Income ($1984):	34617000	4424000	-55000	(0.2%)
de kalb				
Income ($1984):	9577892000	31457800	-62958000	(0.7%)

Table 5.9 (continued)

dodge				
Income ($1984):	85338000	11635000	-10756000	(12.6%)
dooly				
Income ($1984):	66827000	16847000	-4068000	(6.1%)
douglas				
Income ($1984):	533744000	28596000	-2022000	(0.4%)
elbert				
Income ($1984):	125017000	9443000	-236000	(0.2%)
fannin				
Income ($1984):	73273000	10862000	-98000	(0.1%)
fayette				
Income ($1984):	321977000	29101000	-1606000	(0.5%)
floyd				
Income ($1984):	667485000	73010000	-1060000	(0.2%)
forsyth				
Income ($1984):	220251000	10422000	-577000	(0.3%)
franklin				
Income ($1984):	89996000	10164000	-184000	(0.2%)
fulton				
Income ($1984):	9653384000	386374000	-86816000	(0.9%)
gilmer				
Income ($1984):	77247000	8165000	-81000	(0.1%)
gordon				
Income ($1984):	235149000	26775000	-291000	(0.1%)
greene				
Income ($1984):	59371000	5031000	-267000	(0.4%)
gwinnett				
Income ($1984):	1819734000	97594000	-8414000	(0.5%)
habersham				
Income ($1984):	162760000	14669000	-287000	(0.2%)
hall				
Income ($1984):	686389000	38076000	-1565000	(0.2%)
hancock				
Income ($1984):	41497000	2827000	-203000	(0.5%)
haralson				
Income ($1984):	127884000	12193000	-204000	(0.2%)
hart				
Income ($1984):	117210000	10614000	-156000	(0.1%)
heard				
Income ($1984):	56684000	6872000	-90000	(0.2%)
henry				
Income ($1984):	314722000	12431000	-1322000	(0.4%)
houston				
Income ($1984):	671063000	81373000	-410944000*	(61.2%)
jackson				
Income ($1984):	171269000	13984000	-386000	(0.2%)
jasper				
Income ($1984):	60211000	6286000	-1018000	(1.7%)
johnson				
Income ($1984):	47876000	6043000	-724000	(1.5%)

Table 5.9 (continued)

jones				
Income ($1984):	100232000	6243000	-9295000*	(9.3%)
lamar				
Income ($1984):	68871000	6871000	-1421000	(2.1%)
laurens				
Income ($1984):	259263000	28165000	-10327000	(4.0%)
lumpkin				
Income ($1984):	56607000	6264000	-111000	(0.2%)
macon				
Income ($1984):	69837000	9936000	-3371000	(4.8%)
madison				
Income ($1984):	117618000	9833000	-287000	(0.2%)
monroe				
Income ($1984):	109378000	6739000	-4642000	(4.2%)
morgan				
Income ($1984):	90291000	6813000	-341000	(0.4%)
newton				
Income ($1984):	288228000	16710000	-1729000	(0.6%)
oconee				
Income ($1984):	82245000	5777000	-325000	(0.4%)
oglethorpe				
Income ($1984):	52450000	5724000	-88000	(0.2%)
paulding				
Income ($1984):	204025000	9698000	-628000	(0.3%)
peach				
Income ($1984):	144269000	9116000	-31565000*	(21.9%)
pickens				
Income ($1984):	80353000	5094000	-114000	(0.1%)
pike				
Income ($1984):	57434000	4207000	-453000	(0.8%)
polk				
Income ($1984):	214410000	21346000	-331000	(0.2%)
pulaski				
Income ($1984):	50818000	11023000	-8951000	(17.6%)
putnam				
Income ($1984):	85411000	5999000	-1427000	(1.7%)
rabun				
Income ($1984):	45097000	4862000	-55000	(0.1%)
rockdale				
Income ($1984):	368009000	14592000	-1769000	(0.5%)
spalding				
Income ($1984):	400291000	18712000	-2923000	(0.7%)
stephens				
Income ($1984):	147417000	18576000	-207000	(0.1%)
taylor				
Income ($1984):	44145000	6245000	-740000	(1.7%)
telfair				
Income ($1984):	76702000	8072000	-2227000	(2.9%)
towns				
Income ($1984):	23197000	2361000	-44000	(0.2%)

Table 5.9 (concluded)

treutlen				
Income ($1984):	28048000	4490000	-156000	(0.6%)
twiggs				
Income ($1984):	42300000	3565000	-6318000*	(14.9%)
union				
Income ($1984):	31955000	3949000	-62000	(0.2%)
upson				
Income ($1984):	160926000	15082000	-3359000	(2.1%)
walton				
Income ($1984):	235953000	15252000	-895000	(0.4%)
washington				
Income ($1984):	130516000	10465000	-774000	(0.6%)
wheeler				
Income ($1984):	23916000	4920000	-139000	(0.6%)
white				
Income ($1984):	49572000	6099000	-86000	(0.2%)
wilcox				
Income ($1984):	37453000	7913000	-4860000	(13.0%)
wilkinson				
Income ($1984):	73611000	3962000	-2013000	(2.7%)

* Significant at the 90% confidence level.

Figure 5.1

ROI MAP

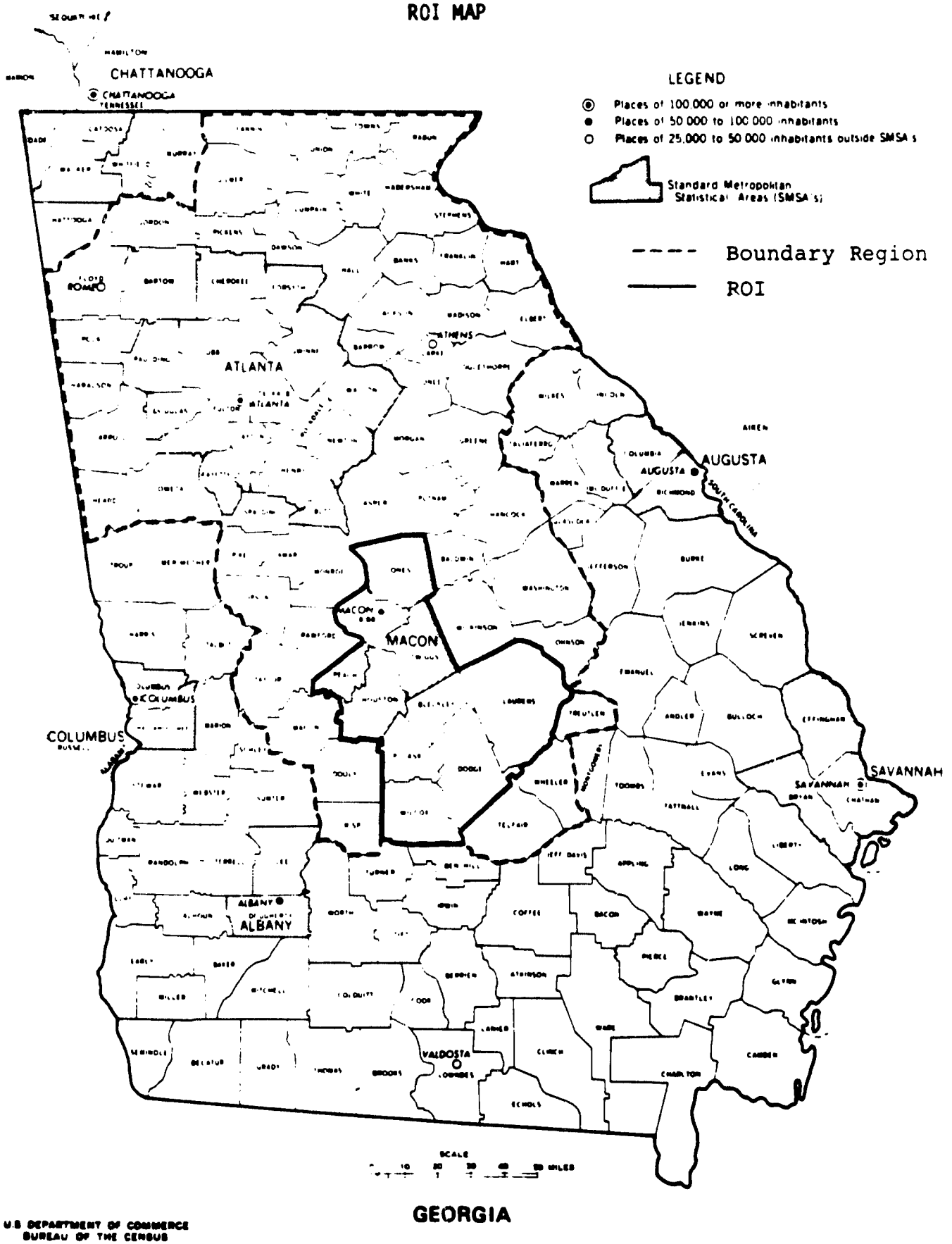


Table 5.10

PERCENTAGE OF COUNTY EMPLOYMENT AND PERSONAL INCOME ATTRIBUTED TO ROBINS AFB IN ROI COUNTIES WITH SIGNIFICANT DEPENDENCE

Counties	Place of Work		Place of Residence
	Employment	Income	Income
Bibb	13.0%	9.4%	15.9%
Bleckley	(5.3)	(5.6)	24.3
Dodge	(2.5)	(2.6)	(12.6)
Houston	73.8	73.4	61.2
Jones	(0.3)	(0.4)	9.3
Laurens	(1.8)	(1.6)	(4.0)
Peach	9.5	7.1	21.9
Pulaski	7.6	(6.9)	(17.6)
Twiggs	(0.2)	(0.1)	14.9
Wilcox	(1.7)	(1.5)	(13.0)

Note: The parentheses indicate where the percentage change (i.e., impact) was not significant.

Source: Tables 5.8 and 5.9

For the purposes of this example, it was decided that these additional counties should be included in the ROI. Although it is not expected that any changes at Robins would have a significant effect in these counties, it is felt that there would be political if not emotional support for their inclusion.

5.2 Identify AOI

5.2.1 Description of Action

The AF is initiating a (hypothetical) action that entails constructing a specialized facility and relocating 250 military personnel to Robins AFB. The key parameters of the project are as follows:

- Construction
  - Start, 1/87
  - Complete, 1/88
  - Cost, $50 million ($20 million for facility and $30 million for specialized equipment)
- Personnel
  - 250 military
  - 100 contractors
  - Personnel build up between June 1987 and June 1988
- Procurement
  - $5 million per year for utilities, spares, and miscellaneous after full operation reached 6/88.

To assist in the preparation of an EIS, there is a need to estimate the amount and geographical distribution of probable effects of this activity. The EIS will distinguish betwen the impacts of the construction and operation of the facility. Thus, AFROI will be applied to each. However, these phases of the program overlap, because some of the operating personnel will start work before construction is complete. It appears that the greatest spending impacts will occur during the first year (1987) and that steady state operations will commence by June 1988. Consequently, the EIS analyst will analyze the impacts occurring in 1987 and 1989 (the first full calendar year of operation). Only the former analysis is presented in this example.

5.2.2 Input Data

The input questionnaire is presented in Table 5.11 and the assumptions are described below.

Number of Affected Personnel: During 1987 the average number of military person years is 31 (125 x 0.5 yr/2). For this analysis, the contractors have been classified as civil service, because their spending patterns are expected to be similar. The average number of contractor

Table 5.11

INPUT QUESTIONNAIRE, ROBINS AFB XYZ PROGRAM

********** REGIONAL INPUTS **********

Project: ROBINS AFB XYZ PROGRAM

County where base is located: HOUSTON

Year of completion of action: 1987

Regional employment multiplier: _____

Regional income multiplier: _____

Total number of affected personnel: 48

# of affected personnel by class
- Permanent military: 31
- Military trainees : 0
- Civil Service : 12
- NAF/BX : 5

Average wages of affected personnel
- Permanent military: $ 18,500
- Military trainees : $ 0
- Civil Service : $ 20,500
- NAF/BX : $ 7,100

Dollar amount change in regional AF expenditures

Base Contracting (Services)	: $	0
Base Contracting (Total)	: $	0
Military Construction Program (MCP)	: $	20,000,000
O&M Contract Construction	: $	0
Non-Appropriated Fund (NAF) Construction	: $	0
Military Family Housing (MFH) Construction	: $	0
Other Construction	: $	0
PL 81-874 Public School Program	: $	1900
CHAMPUS	: $	4300
Supplemental/Cooperative Care	: $	400
Education Programs	: $	0
All Other Programs (except BX)	: $	0

********** SYSTEM PARAMETERS **********

Working dependents full time equivalency factor: _____

Fraction of working dependents
- Permanent military: _____
- Military trainees : _____
- Civil Service : _____
- NAF/BX : _____

Fraction of AF employees living on-base
- Permanent military: 0
- Military trainees : 0
- Civil Service : _____
- NAF/BX : _____

Table 5.11 (continued)

Fraction of income spent in boundary region (on and off-base)
  Permanent military: --------
  Military trainees : --------
  Civil Service   : --------
  NAF/BX   : --------

Fraction of income spent off-base by persons living off-base
  Permanent military: --------
  Military trainees : --------
  Civil Service   : --------
  NAF/BX   : --------

Fraction of income spent off-base by persons living on-base
  Permanent military: --------
  Military trainees : --------
  Civil Service   : --------
  NAF/BX   : --------

Fraction of construction expenditures for
  materials: --------
  labor   : --------

Fraction of contracted service expenditures for
  materials: --------
  labor   : --------

Fraction of BX sales from local suppliers: --------

Gravity model exponent: --------

Forecast confidence level: --%

CPI price deflators
  Base year: -----
  Inputs   : -----
  Outputs : -----

********** COUNTY INPUTS for >> HOUSTON << **********

Population: ------

Employment multiplier: 1.5622

Income multiplier: 1.4412

Number of affected personnel by class
  Permanent military: 30
  Military trainees : 0
  Civil Service   : 1
  NAF/BX   : 4

Change in expenditures
  Base Contracting (Services)   : $ ----------
  Base Contracting (Total)   : $ ----------
  Military Construction Program (MCP)   : $ 4123,000
  O&M Contract Construction   : $ ----------
  Non-Appropriated Fund (NAF) Construction   : $ ----------
  Military Family Housing (MFH) Construction   : $ ----------
  Other Construction   : $ ----------
  PL81-874 Public School Program   : $ ----------
  CHAMPUS   : $ ----------
  Supplemental/Cooperative Care   : $ ----------
  Education Programs   : $ ----------
  All Other Programs (except BX)   : $ ----------

Table 5.11 (concluded)

Trade and service employment: _____

Trade and service sales per worker: $ _____

Trade and service income per worker: $ _____

Service income per worker: $ _____

Construction income per worker: $ _____

Distance from installation: 3

Distance between _____ and

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

BEA employment by place of work

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

BEA total income by place of work

_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____

BEA net income by place of residence

_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____

person years during 1987 is 12. It is estimated that NAF and BX employment will increase by 5 during this period.

Average Wages: Based on the ranks of the military personnel involved, the average wage is estimated to be $18,500 per year. The contractors will make an average of $20,500 and NAF/BX will earn the base average.

Expenditures: The facility will be constructed through MCP for $20 million. It is assumed that the specialized equipment will be purchased outside the region. Base contracting will not be affected until full operation is achieved in 1988. The spending in school and health programs is based on present on-base per capita expenditures prorated by the time the military are present in 1987.

Fraction On-Base: It is assumed that the new military will exhibit the residential patterns of those already assigned to the base.

County Inputs: The present pattern of distribution was used to prorate county level change. Allocations were made to Houston County and the balance was allocated by AFROI. Based on the extent of the Robins ROI and relatively small impacts of this action, the Macon BEA was selected as the boundary region.

5.2.3 Results

The AFROI model indicated that no counties would be significantly affected by this action. The confidence level was adjusted from the standard 90% to 60% and the change in employment in Houston and Bibb counties exceeded the threshold. It was, therefore, concluded that the action would have no significant effects among the parameters measured and that the greatest change would occur in Houston and Bibb counties (see Tables 5.12 and 5.13).

**** AFROI MODEL RESULTS FOR Robins AFB XYZ Program ****

Table 5.12

SIGNIFICANCE OF PLACE OF WORK IMPACTS

County	Forecast in 1987	Std Error of Forecast	Total Impacts	
baldwin				
Employment:	18834	139	5	(0.0%)
Income ($1984):	289684000	2628000	67000	(0.0%)
bibb				
Employment:	79524	181	338*	(0.4%)
Income ($1984):	1391542000	14288000	4458000	(0.3%)
bleckley				
Employment:	4328	57	5	(0.1%)
Income ($1984):	41578000	1547000	56000	(0.1%)
crawford				
Employment:	1603	18	2	(0.1%)
Income ($1984):	14538000	469000	16000	(0.1%)
crisp				
Employment:	9706	113	6	(0.1%)
Income ($1984):	125583000	3753000	64000	(0.1%)
dodge				
Employment:	6899	47	3	(0.0%)
Income ($1984):	70541000	2080000	34000	(0.0%)
dooly				
Employment:	4835	45	4	(0.1%)
Income ($1984):	55187000	3275000	43000	(0.1%)
hancock				
Employment:	1971	41	1	(0.0%)
Income ($1984):	23585000	414000	7000	(0.0%)
houston				
Employment:	38423	268	812*	(2.1%)
Income ($1984):	867410000	23988000	13121000	(1.5%)
johnson				
Employment:	3559	43	0	(0.0%)
Income ($1984):	37895000	1064000	4000	(0.0%)
jones				
Employment:	2831	32	0	(0.0%)
Income ($1984):	38090000	980000	4000	(0.0%)

Table 5.12 (concluded)

laurens				
Employment:	21063	208	9	(0.0%)
Income ($1984):	292783000	6020000	115000	(0.0%)
macon				
Employment:	5808	118	7	(0.1%)
Income ($1984):	77741000	2934000	72000	(0.1%)
monroe				
Employment:	8159	122	6	(0.1%)
Income ($1984):	130685000	3139000	71000	(0.1%)
peach				
Employment:	9400	83	36	(0.4%)
Income ($1984):	136482000	1535000	413000	(0.3%)
pulaski				
Employment:	3337	13	7	(0.2%)
Income ($1984):	37990000	1857000	73000	(0.2%)
putnam				
Employment:	5298	88	1	(0.0%)
Income ($1984):	99593000	1997000	9000	(0.0%)
taylor				
Employment:	3263	41	2	(0.0%)
Income ($1984):	35727000	1165000	19000	(0.1%)
telfair				
Employment:	5806	66	1	(0.0%)
Income ($1984):	80670000	1616000	14000	(0.0%)
treutlen				
Employment:	2148	18	0	(0.0%)
Income ($1984):	19120000	717000	2000	(0.0%)
twiggs				
Employment:	2925	31	0	(0.0%)
Income ($1984):	54141000	1294000	3000	(0.0%)
washington				
Employment:	9516	50	2	(0.0%)
Income ($1984):	145183000	2211000	25000	(0.0%)
wheeler				
Employment:	1538	25	0	(0.0%)
Income ($1984):	19592000	932000	2000	(0.0%)
wilcox				
Employment:	2152	11	1	(0.0%)
Income ($1984):	24118000	1424000	8000	(0.0%)
wilkinson				
Employment:	4242	51	2	(0.1%)
Income ($1984):	75737000	949000	22000	(0.0%)

* Significant at the 60% confidence level.

**** AFROI MODEL RESULTS FOR Robins AFB XYZ Program ****

Table 5.13

SIGNIFICANCE OF PLACE OF RESIDENCE IMPACTS

County		Forecast in 1987	Std Error of Forecast	Total Impacts	
baldwin					
	Income ($1984):	243870000	2179000	187000	(0.1%)
bibb					
	Income ($1984):	1293274000	14892000	5010000	(0.4%)
bleckley					
	Income ($1984):	66000000	1921000	92000	(0.1%)
crawford					
	Income ($1984):	33061000	599000	62000	(0.2%)
crisp					
	Income ($1984):	118598000	3347000	98000	(0.1%)
dodge					
	Income ($1984):	86049000	2289000	63000	(0.1%)
dooly					
	Income ($1984):	67443000	3314000	64000	(0.1%)
hancock					
	Income ($1984):	42063000	556000	12000	(0.0%)
houston					
	Income ($1984):	682132000	16005000	11509000	(1.7%)
johnson					
	Income ($1984):	48719000	1189000	15000	(0.0%)
jones					
	Income ($1984):	102718000	1228000	322000	(0.3%)
laurens					
	Income ($1984):	264341000	5540000	181000	(0.1%)
macon					
	Income ($1984):	70594000	1954000	80000	(0.1%)
monroe					
	Income ($1984):	112454000	1326000	116000	(0.1%)
peach					
	Income ($1984):	147406000	1793000	526000	(0.4%)
pulaski					
	Income ($1984):	51002000	2168000	84000	(0.2%)

Table 5.13 (concluded)

putnam					
	Income ($1984):	87812000	1180000	28000	(0.0%)
taylor					
	Income ($1984):	44558000	1228000	40000	(0.1%)
telfair					
	Income ($1984):	78286000	1588000	22000	(0.0%)
treutlen					
	Income ($1984):	28475000	883000	7000	(0.0%)
twiggs					
	Income ($1984):	42895000	701000	149000	(0.3%)
washington					
	Income ($1984):	133033000	2058000	44000	(0.0%)
wheeler					
	Income ($1984):	24152000	968000	6000	(0.0%)
wilcox					
	Income ($1984):	37720000	1556000	18000	(0.0%)
wilkinson					
	Income ($1984):	75290000	779000	46000	(0.1%)

* Significant at the 60% confidence level.

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GLOSSARY

AF	Air Force
AFB	Air Force Base
AFROI	Air Force Region of Influence Model
AOI	Area of Influence
BEA	Bureau of Economic Analysis
CEAS	Comprehensive Economic Analysis System
CECORS	Civil Engineering Contract Reporting Subsystem
CERL	Construction Engineering Research Laboratory
DoD	Department of Defense
EIAP	Environmental Impact Analysis Process
EIFS	Economic Impact Forecast System
EIS	Environmental Impact Statement
ERIS	Economic Resource Impact Statement
ESC	Engineering Service Center (Tyndall AFB)
ETIS	Environmental Technical Information System
LECS	Local Economic Consequences System
NEPA	National Environmental Policy Act
ROI	Region of Influence
TDY	Temporary Duty
UNIX	(A trademark of Bell Laboratories)

Appendix A

A MODEL FOR IDENTIFYING AIR FORCE REGIONS OF INFLUENCE

1.0. Introduction

This paper describes a quantitative procedure for defining Air Force ROIs. The proposed method is a modified version of the familiar economic base model (Tiebout 1962) which incorporates a gravity-potential sub-model to determine the spatial distribution of direct expenditures due to an Air Force activity.

The model has been written in computer code and is available as a profile of the Comprehensive Economic Analysis System (CEAS) maintained by the U.S. Army Corps of Engineers' Construction Engineering Research Laboratory (CERL). The Air Force Region of Influence model (AFROI) is a menu-driven program designed for interactive use, providing options for creating, modifying, storing, and retrieving data files as well as generating outputs in both tabular and graphic form.

An important consideration during the model's design phase was the degree of integration with existing CEAS programs and databases. In its current implementation, AFROI may be used as a stand-alone program or in conjunction with the Economic Impact Forecast System (EIFS) (Robinson et al. 1984). In the latter case, EIFS is used to gather many of the area-specific inputs required to run the AFROI model, thus sparing the analyst much of the time-consuming chore of data collection and entry. AFROI can also use the county employment and income multipliers generated by EIFS to carry out its own impact estimation procedure.

In this paper the theoretical and operational aspects of AFROI are described. Attention is first focused on the problem of choosing the initial set of counties to include in the impact study -- which is referred to as the "boundary region." This is followed by an explanation of the approach used to calculate the change in direct expenditures associated with an AF action, the diffusion of these expenditures among counties within the boundary region, and the esti-

mation of the direct and total employment and income impacts occurring in each county. Finally, the statistical procedure for assessing the significance of county economic impacts is described.

2.0. The Boundary Region

A "boundary region" is defined as the geographic area large enough to contain nearly all of the direct and indirect impacts from an AF action. Some reasonable guidelines should be followed in selecting a boundary region. For instance, the boundary region should be largely self-sufficient and contain an important trade and service center. By defining the boundary region this way, most of the trading activity generated by installation spending can be accounted for.

Of all the pre-defined types of geographic areas available to choose from (SMSAs, CMSAs, etc.), the Bureau of Economic Analysis (BEA) Economic Areas are perhaps the most suitable choices for the boundary region. BEA areas are functional economic regions consisting of counties which have strong trade and commuting ties to a metropolitan center. There are 183 such areas in total, covering the entire U.S., including Hawaii and Alaska. Quoting from the U.S. Department of Commerce publication *BEA Economic Areas:*

> The Bureau of Economic Analysis (BEA) Economic Areas are nodal functional areas delineated to facilitate regional economic analysis. Each area consists of an economic node -- a standard metropolitan statistical area (SMSA), or similar area, that serves as a center of economic activity -- and the surrounding counties that are economically related to the center. To the extent possible, each area includes the place-of-work and place-of-residence of its labor force (U.S. Dept. of Commerce 1977, p. 1).

While single BEA areas are logical candidates for boundary regions, alternate selection strategies are certainly possible. For example, an analyst may want to initially include only those counties that are within a one hour commuting radius of the affected installation.[1] In

[1] A recent survey of military and civilian Air Force employees revealed that fewer than 1 percent reside farther than 50 miles from the base where they work. See, Gunther (1982, Table 10, p. 17).

the situation where an installation borders on two BEA regions, one could include both areas in the boundary region or, again, chose counties within a specified radial distance from the installation.

No matter how carefully the boundary region is chosen, questions will inevitably arise in public hearings as to why a particular area was not included in the study. The AFROI program facilitates the analysis of differently defined boundary regions by allowing the analyst to easily add data for one or more counties to an existing set of model inputs. This flexibility provides the analyst with the means to examine, at minimum added cost in time and effort, how individual counties influence the spatial distribution of economic impacts associated with an Air Force action.

3.0. Calculating the Change in Direct Expenditures

Once the boundary region has been selected, the next step involves determining both the amount and initial distribution of the change in direct expenditures from a proposed action. The AFROI model assumes direct expenditures consist of: wages and salaries paid to military and civilian employees; base contracting; construction; and other. The following subsections explain how each of these direct expenditure items are calculated in the AFROI methodology.

3.1.1. Wages and Salaries

In the AFROI model, personnel are classified in one of four categories: permanent military, military trainee, civil service, or nonappropriated fund/base exchange (NAF/BX). A further distinction is made between personnel living on-base and those living in the region around the installation.

The AFROI model assumes the initial location of a change in wage and salary expenditures to be the employees' county of residence. The total change in wage and salary expenditures is calculated by summing the change in off-base expenditures by each of the four employment categories: (1) permanent military; (2) military trainees; (3) civil service; (4) NAF/BX.

$$WS_i = \sum_{k=1}^{4} EM_i^k * \overline{M}^k * ((\%onbase^k * \%on^k) + ((1 - \%onbase^k) * \%off^k)) \quad (A.1)$$

Where WS_i is the total change in wage and salary expenditures by AF employees residing in county i (but not necessarily spent in i), EM_i^k is the number of class k base employees residing in county i, $\overline{M}^k$ is the average wage paid to employees of class k, $\%onbase^k$ the percent of class k military employees living on-base, $\%on^k$ is the percent of income spent off-base by employees of class k living on-base, $\%off^k$ is the percent of income spent off-base by employees of class k living off-base.[2]

Since AF military employees and their dependents have BX privileges, a portion of their disposable income is spent on-base. By default, it is assumed that five percent of all expenditures made on-base by eligible personnel are indirect sales to suppliers located within the boundary region.[3] In the AFROI model, this source of impacts is treated as a change in procurement expenditures rather than a direct change in wage and salary earnings and is discussed in the next section.

3.1.2. Base Contracting

Air Force purchases of goods and services are made through national and regional procurement systems and the base contracts office. Purchases by the latter include such items as:

[2]The values for $\%onbase^k$, $\%on^k$, and $\%off^k$ are derived from the AF socioeconomic survey data collected by Gunther (1982). The values of $\%on^k$ and $\%off^k$ are assumed to be equivalent until better information becomes available.

[3]See Pierce (1985, p. 9). This figure may be changed by the user if local conditions differ.

supplies and equipment, fuel (non-aviation), services, utilities, communication, and transportation.

The AFROI methodology assumes that all services (e.g., janitorial and grounds-keeping services) are supplied by firms located within the boundary region. Base contracting expenditures for materials are included only if contracts are held by firms headquartered in the boundary region.[4] As previously mentioned, five percent of total BX and other expenditures made on-base by AF employees and their dependents is assumed, by default, to be indirect sales to suppliers located within the boundary region. This amount is calculated internally by the AFROI program, proportionally split between expenditures for goods and services, and added to base contracting expenditures.

Base contracting expenditures are then separated by the AFROI model into materials and labor components. This is done to more accurately portray the local employment and income impacts associated with a change in the amount of goods and services purchased. This step is shown in the following equations.

$$Pmat_i = (PTOT_i - PSRV_i) + PSRV_i * \%Pmat \quad (A.2)$$

$$Plab_i = PSRV_i * \%Plab \quad (A.3)$$

$Pmat_i$ is the amount of procurement expenditures for materials in county i, $Plab_i$ the amount of expenditures for labor in i, $PSRV_i$ is the service-related expenditures in i, $PTOT_i$ is the total expenditures in i, $\%Plab$ the percent for labor, and $\%Pmat$ the percent for materials. The expression $(PTOT_i - PSRV_i)$ defines the dollar value of materials purchased.[5]

[4]The breakdown between service and materials procurements by location of vendor is generally available from the base contracts office.

[5]$\%Plab$ and $\%Pmat$ are derived from the 1977 Input-Output Table for the U.S., SIC 734 (Services to Dwelling and Other Buildings). See, U.S. Department of Commerce, Bureau of Economic Analysis, (1984) *The Detailed Input-Output Structure of the U.S. Economy, 1977.* Volume 1, Table 1. The Use of Commodities by Industries, 1977. The sum of the terms $\%Plab$ and $\%Pmat$ is less than or equal to 1.

3.1.3. Construction

There are typically three funding sources for construction expenditures: Military Construction Program (MCP); Operation and Maintenance (O&M); and Nonappropriated Fund (NAF). MCP projects generally include large-scale (greater than $500,000) construction for mission support. New construction, maintenance and repair of NAF facilities (Officers' Club, NCO Club, and other Morale, Welfare, and Recreation (MWR) activities) are funded through the proceeds of NAF activities. Both MCP and NAF expenditures may vary considerably from year to year; therefore, an average value, perhaps over the last 5 years, should be used as input to the AFROI program. The O&M contract construction program is funded at the base level and the amount expended each year remains fairly constant. Other programs, e.g. Military Family Housing (MFH), when they comprise a significant proportion of an installation's construction budget, should also be included. Programs like MFH, which focus primarily on new construction, should be treated in the same manner as MCP and NAF construction. Otherwise, an approach similar to that adopted for O&M should be used.

The impacts from a change in construction expenditures are assumed to fall entirely within the boundary region, even if the home office of the contractor is located outside the area. This assumption is based on the belief that the majority of construction workers will be hired locally regardless of the home base of the general contractor[6]. Since the boundary region is assumed to be largely self-sufficient, it is expected that most materials purchases will also be made locally.

[6]See Dunning (1981, pp. 57-74) for a discussion of the local, non-local workforce composition of Army Corps of Engineers construction projects.

Construction expenditures are also separated into materials and labor components as follows

$$Cmat_i = C_i * \%Cmat \quad (A.4)$$

$$Clab_i = C_i * \%Clab \quad (A.5)$$

$Cmat_i$ is the amount of construction expenditures for materials in county i, $Clab_i$ the amount of expenditures for labor in i, C_i is total construction expenditures in i, $\%Clab$ the percent for construction labor, and $\%Cmat$ the percent for materials.[7]

3.1.4. Other Expenditures

In addition to wages and salaries, procurement, and construction expenditures, the Air Force often provides funding for programs related to the education and health of its employees and their dependents. For example, the AF offsets the cost of tuition for military personnel who enroll in vocational and other courses provided on base by private schools and universities. Another program is the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) which allows active duty military, military retirees, and dependents to obtain civilian medical care when the required services are not available from a military medical facility or when travel to that facility places an undue hardship on the dependent. Because federal installations are exempt from local property taxes, a third program, Public Law PL 81-874, provides funds to public school systems based on the average daily attendance of children of federal employees. Other programs not mentioned may be included here as well depending on their importance to the installation under study. The AFROI model assumes all these expenditures occur within the boundary region.

[7] $\%Clab$ and $\%Cmat$ are derived from the 1977 Input-Output Table for the U.S., Industry 12.0212 (Maintenance and Repair of Military Facilities). See, U.S. Department of Commerce, Bureau of Economic Analysis, (1984) *The Detailed Input-Output Structure of the U.S. Economy, 1977.* Volume 1, Table 1. The Use of Commodities by Industries, 1977.

3.1.5. Total Change in Direct Expenditures

From these four sources of spending -- wages and salaries, procurements, construction, and other -- the initial direct change in expenditures in county i from an AF action (X_i) is calculated as

$$X_i = WS_i + OTH_i + Pmat_i + (Plab_i * \%off^3) + Cmat_i + (Clab_i * \%off^3) \quad (A.6)$$

OTH_i is the change in "other" expenditures and all remaining variables are as previously defined. Since $Plab_i$ and $Clab_i$ are payments to labor, they are multiplied by the propensity to consume, here represented by $\%off^3$, (i.e., the fraction of civil service employees' income spent off-base).

4.0. Initial Distribution of Direct Expenditures

The AFROI model assumes that the initial distribution of direct expenditures is given by the residential pattern of AF employees and the home office location of vendors and construction contractors. In situations where a complete accounting of this information is not possible, for example, new projects (i.e. those resulting in an increase of AF activity) and installations contracting with construction firms located outside the boundary region, the initial distribution of direct expenditures must be estimated before the region of influence can be defined. The following sub-sections describe how this is handled in the AFROI model.

4.1.1. A Gravity-Potential Model

The approach taken to estimate the initial distribution of direct AF expenditures is a generalized production-constrained gravity-potential model similar to the one developed by Lakshmanan and Hansen (1965). A variant of this method is expressed as

$$T_{ij} = A_i * O_i * W_j * d_{ij}^{-\beta} \quad (A.7)$$

$$A_i = \frac{1}{\sum_{j=1} W_j * d_{ij}^{-\beta}} \tag{A.8}$$

T_{ij} is the change in activity occurring in county j resulting from a change in county i, A_i is known as a "balancing or normalizing" factor, O_i is the total change in county i, W_j is a measure of locational attraction ("size") of county j, d_{ij} is the distance between i and j (centroid to centroid), and β is a parameter of the model.

This model is constrained with respect to total activity

$$\sum_{j=1} T_{ij} = O_i \tag{A.9}$$

The total change in county j, T_j, is calculated by summing (A.7) over all i.

$$T_j = \sum_{i=1} T_{ij} \tag{A.10}$$

Eq. (A.7) is used to allocate direct expenditures from an action to counties within the boundary region when prior information from AF sources does not exist. This step is carried out for each of the four military and civilian direct employment categories, as well as procurement, construction, and other expenditures.

In order to operationalize this model, a number of theoretical and practical issues must first be resolved. These include: selection of an appropriate "mass" term to indicate the relative size of each county to attract AF expenditures; the choice of distance measure; and the selection of a distance parameter (β) to indicate the friction of distance.

4.1.2. Size Measure

The main considerations in choosing a variable or set of variables to measure locational attraction (W_j) are the type of interaction involved and availability of data. In determining the initial distribution of direct expenditures, the size measure is assumed to vary depending

on the type of activity being allocated. For wages and salaries, total county population is used as the size measure to indicate the relative attractiveness of counties as places of residence. The size measure for procurement and construction expenditures is county trade and service employment which is used as a proxy measure of each county's economic influence. Finally, the "other" category of expenditures is also allocated according to total county population since these payments are mostly oriented toward social welfare, e.g., education and health care maintenance.

4.1.3. Distance Measure

Inter-county distances in the AFROI model are represented by the distance between county population centroids. The use of travel-time or cost data was considered, but were thought to be unavailable for most AF installations. When used with EIFS, these distance inputs are automatically made available to AFROI.

A problem with the use of spatial interaction models is how to account for the distance between i and itself. This was resolved arbitrarily by setting d_{ii} equal to one-half the distance to i's nearest neighbor (Abler et al. 1971, p. 217; Haggett et al. 1977, p. 40).

4.1.4. Distance Parameter

The purpose of the parameter β on the distance term in eq. (A.7) is to specify the relationship distance has in determining the spatial distribution of a given activity. In the AFROI model a default value of 2 is assumed for the parameter β. This figure is consistent with Reilly's (1929) early study on the "law" of retail gravitation and with Huff (1973).[8] For the sake of simplicity, this same β is used to allocate both AF employees and expenditures.

[8]Also see Isard (1960, pp. 508-512) for a discussion of factors influencing the size of the distance exponent.

The AFROI program has an option to calibrate a value for the parameter β which best reflects conditions for a specific region.[9] A word of caution is warranted, however, when using county-level data to estimate the β term. This has to do primarily with the small number of counties (generally less than 20) one would typically use to define the boundary region. Batty (1976, p.213), citing the work of Broadbent (1969a, 1969b), suggests that for the calibration process to be meaningful the ratio of intra-zonal to total interaction should be as small as possible, and that an acceptable value might be 0.1. If this ratio is greater than 0.1, Batty recommends that the analyst rezone the study area to show more interaction.

In the AFROI model, the analyst is restricted to using county-level data since many inputs needed to conduct an impact analysis are only available for counties or county aggregates (e.g., SMSAs). Therefore, if most AF employees live and work in the same county, attempts to calibrate β may not yield useful results. Nevertheless, for those cases where sufficient interaction is believed to exist, use of this option is recommended to obtain an estimate for β that better reflects conditions specific to the site being studied.

Some studies have also included an exponent on the size measure, or $W_j^{-\beta_1}$, to indicate the relative influence of the locational attractiveness of an area. In this study, as in Lakshmanan and Hansen (1965), the exponent on W_j is implicitly assumed equal to 1.

5.0. Spatial Diffusion of Direct Expenditures

A core assumption of the AFROI model is that the full impact of an AF action is not likely to be restricted only to those counties receiving an initial change in direct expenditures. Due to trading activity and the shopping patterns of individuals, these impacts are spread among all counties of the boundary region to a greater or lesser degree.

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[9] An iterative procedure developed by Hyman (1969) is used to determine an optimal value for β given a mean trip length for the journey-to-work. See the Technical Notes for details.

Specifically, the model is formulated as

$$S_{ij} = A_i * X_i * TS_j * d_{ij}^{-\beta} \qquad \text{(A.11)}$$

Where S_{ij} is the amount of direct expenditures (sales) "leaked" to county j from county i, X_i is the total direct expenditure change in i, and the other variables are defined as in eq. (A.7). The attraction term, TS_j, is the total employment in the retail and wholesale trade and service sectors.

Total expenditures leaked to j (S_j) is expressed as

$$S_j = \sum_{i=1} S_{ij} \qquad \text{(A.12)}$$

In brief, eq. (A.11) is used to estimate how much of the initial direct impact at i (e.g., a change in wage and salary income paid to resident employees) remains in i (S_{ii}) and how much is leaked to communities with which i has economic ties (S_{ij}). In other words, j will attract to itself any income change in i in proportion to the relative locational attraction of j with respect to i.

6.0. Impacts Calculation

Once the final distribution of direct expenditures is made using eqs. (A.11) and (A.12), the next step is the calculation of direct and total economic impacts. Indirect impacts are implicitly defined as the difference between total and direct.

The AFROI model considers the effects of an AF action on three key economic variables: sales volume, employment, and income. These variables are considered key in that they often indicate trends in other factors of interest in impact analysis such as local government revenues and expenditures, the local housing market, population, number of school-age children, welfare dependency, and so on. While explicit consideration of these latter indicators is beyond the scope of the present study, it is hoped that providing estimates of the

change in sales, employment, and income will aid the analyst in gauging the relative impact of these other important factors.

In most impact studies the distinction between the location of place of work and place of residence impacts is often blurred. This may result in under or over-counting impacts for a given county since it frequently occurs that people reside in a county different from the one in which they work. An attempt is made in the AFROI model to estimate the place of work and place of residence impacts for both employment and income. This procedure is explained in detail in the sub-sections that follow.

6.1.1. Direct Impacts

The direct change in trade and service sales volume in county i is simply S_i, calculated using eq.(A.12.) The direct change in employment by place of work (Edw_i) is found by dividing the direct change in sales volume by an average sales to worker ratio for the trade and service sectors in county i ($TSspw_i$).

$$Edw_i = \frac{S_i}{TSspw_i} \tag{A.13}$$

If i is the county where the Air Force installation is located, then Edw_i is calculated as

$$Edw_i = \frac{S_i}{TSspw_i} + \frac{\sum_{j=1} Plab_j}{SERypw_i} + \frac{\sum_{j=1} Clab_j}{Cypw_i} + \sum_{j=1}\sum_{k=1} EM_j^k \tag{A.14}$$

$SERypw_i$ is the average wage for the service sector in county i, $Cypw_i$ is the construction sector average wage in i, and all other variables are as previously defined. The second term on the right hand side of eq. (A.14) represents the service workers contracted by the installation, the third term construction workers, and the fourth term military and civilian AF employees.

Calculation of direct income impacts by place of work follows in a straightforward manner once employment impacts have been determined. For direct income impacts, an average wage for the trade and service sectors ($TSypw_i$) is estimated and multiplied by the direct change in employment.

$$Ydw_i = \left(\frac{S_i}{TSspw_i}\right) * TSypw_i \qquad (A.15)$$

If i is the county where the installation is located

$$Ydw_i = \left(\frac{S_i}{TSspw_i}\right) * TSypw_i + \sum_{i=1} Plab_i + \sum_{i=1} Clab_i + \sum_{i=1}\sum_{k=1} EM_i^k * \overline{M}^k \qquad (A.16)$$

Direct place of residence employment impacts for county j are given as

$$Edr_j = \sum_{i=1} E_{ij} + \frac{Plab_j}{SERypw_j} + \frac{Clab_j}{Cypw_j} + \sum_{k=1} EM_j^k \qquad (A.17)$$

Where,

$$E_{ij} = A_i * \left(\frac{S_i}{TSspw_i}\right) * POP_j * d_{ij}^{-\beta} \qquad (A.18)$$

and

$$A_i = \frac{1}{\sum_{j=1} POP_j * d_{ij}^{-\beta}} \qquad (A.19)$$

E_{ij} is the number of persons who work in county i but reside in county j. For simplicity, the assumption is made that construction and service workers -- the terms containing $Plab_j$ and $Clab_j$ in eq. (A.17) -- reside in the same county where the expenditures are made. Eq. (A.18) is similar to eq. (A.11), except the attraction term now is total population POP_j.

The change in income by place of residence also relies on the estimation of employment impacts. Direct income change is expressed as

$$Ydr_j = \sum_{i=1} E_{ij} * TSypw_j + Plab_j + Clab_j + \sum_{k=1} EM^k * \overline{M}^k \qquad (A.20)$$

6.1.2. Total Impacts

Total sales impacts in county i ($TOTSALES_i$) are calculated by multiplying S_i by a sales multiplier (Ms_i). While data necessary for estimating sales multipliers are available from the Census Bureau's economic censuses, this procedure has not been made automatic in EIFS. Thus, like EIFS, the AFROI model uses an employment multiplier as a proxy for the sales multiplier.

$$TOTSALES_i = Ms_i * S_i \qquad (A.21)$$

Total employment impacts by place of work are

$$Etw_i = Me_i * \left(\frac{S_i}{TSspw_i} \right) \qquad (A.22)$$

Where Me_i is an employment multiplier for county i. Again, if i contains the AF installation, then

$$Etw_i = Me_i * \left(\frac{S_i}{TSspw_i} \right) + \frac{\sum_{j=1} Plab_j}{SERypw_i} + \frac{\sum_{j=1} Clab_j}{Cypw_i} + \sum_{j=1} \sum_{k=1} EM_j^k \qquad (A.23)$$

Total place of work income impacts are

$$Ytw_i = My_i * \left(\frac{S_i}{TSspw_i} \right) * TSypw_i \qquad (A.24)$$

Or, if i is the site of the installation

$$Ytw_i = My_i * \left(\frac{S_i}{TSspw_i} \right) * TSypw_i + \sum_{i=1} Plab_i + \sum_{i=1} Clab_i + \sum_{i=1} \sum_{k=1} EM_i^k * \overline{M}^k \qquad (A.25)$$

Finally, total employment impacts by place of residence are calculated as

$$Etr_j = Me_j * \sum_{i=1} E_{ij} + \frac{Plab_j}{SERypw_j} + \frac{Clab_j}{Cypw_j} + \sum_{k=1} EM_j^k \qquad \text{(A.26)}$$

While total income impacts by place of residence are

$$Ytr_j = My_j * \sum_{i=1} E_{ij} * TSypw_j + Plab_j + Clab_j + \sum_{k=1} EM^k * \overline{M}^k \qquad \text{(A.27)}$$

6.1.3. Working Dependents

Another component of employment change not considered thus far is the spouses and other dependents of AF employees who would leave the area and their jobs following a realignment action. In the AFROI model, the number of working AF dependents is calculated but not included as a separate source of employment and income impacts in defining the region of influence. The reasons for this decision are as follows: First, many working dependents of Air Force employees hold NAF positions which are already counted among the direct employment impacts. Second, non-basic private sector jobs held by working dependents affected by a realignment action are accounted for by application of the economic base multipliers. Thus, listing working dependents as a additional source of net change in local employment and income would constitute double-counting. Third, jobs held by AF dependents in industries not reliant on military expenditures (e.g., other "basic" industries) would likely be filled by local unemployed workers or inmigrants; assuming adequate labor force mobility and availability of appropriate skills. Therefore, calculating the direct and indirect change in employment and income in the usual way should account for the majority of impacts caused by the relocation of working AF dependents.

While AF dependents are not included as a source of income and employment impacts, it was decided their number should be reported for the sake of completeness. An attempt was made to compute the number of working dependents both by place of residence and place of work. For county i, the number of resident working dependents is given as

$$DEPr_i = \%w^k * EM_i^k * fac \qquad (A.28)$$

Where $\%w^k$ is the proportion of AF employee category k dependents who work, EM_i^k the number of employees of category k who reside in county i, and fac is the average percent time dependents are employed (0.5 is assumed, where 1.0 = full time).

The AFROI model assumes that working dependents commute, possibly to counties other than the one in which they reside, to take up jobs. It is further assumed that the number of dependents living in county i and working in county j ($DEPw_{ij}$) is proportional to the size of the trade and service workforce in j (TS_j) and inversely related to the distance between i and j (d_{ij}). Again, using a gravity formulation, we have

$$DEPw_{ij} = A_i * DEPr_i * TS_j * d_{ij}^{-\beta} \qquad (A.29)$$

where

$$A_i = \frac{1}{\sum_{j=1} TS_j * d_{ij}^{-\beta}} \qquad (A.30)$$

The total number of dependents employed in j is given as

$$DEPw_j = \sum_{i=1} DEPw_{ij} \qquad (A.31)$$

7.0. Adjustment of Impacts

After employment and income impacts have been estimated for each county, an adjustment is made to reflect the forecasted impacts for the entire boundary region. Although primarily an accounting procedure, this adjustment also reflects the influence of inter-county and associated feedback effects. These occur, for example, when two counties, i and j, export goods to each other. If an economic disturbance in county i decreases the demand for goods produced in county j, the reduction in j's income may result in lower imports from i. This,

in turn, leads to additional repercussions in j. Impacts from this second source are known as feedback effects.

The adjustment procedure consists of applying regional multipliers to the total direct change in employment and income calculated for the entire boundary region and comparing these regional impacts to the sum of the individual county impacts. If the former is greater, county impacts are upwardly adjusted in proportion to the impacts already calculated for each county. If the sum of the county-level impacts exceeds the boundary region total impacts, no adjustment -- either upward or downward -- is made. The rationale being that it is better to present a "worst case" scenario than to assume impacts are less simply because of empirical difficulties in estimating the multipliers.

8.0. Testing Significance of Impacts

So far the discussion has been concerned solely with the calculation of economic impacts. The next step deals with formally defining the region of influence for an AF installation. The approach for determining which counties should be included in the ROI relies on a comparison of forecasted total employment and income for each county, assuming no change in status of the military installation, to total county employment and income given that an AF action occurs. The intent is to include only those counties in the ROI that receive "significant" impacts, i.e., impacts that would not otherwise be anticipated given historical growth trends in economic activity. Because the relative magnitude of impacts is being compared, it is possible, using this approach, to include some counties in the ROI which experience smaller absolute changes in employment, for example, than counties that are not included. The reason for this, of course, is that a county having a small work force (say, 5,000 workers) and losing 1,000 jobs is more likely to qualify as receiving significant impacts than a county with 50,000 employed and losing 2,000 jobs. What is considered important to

measure, therefore, is not strictly the absolute change in employment or income but the relative hardship the county might experience as a result of changes affecting the local economic base.

Procedurally, the first step is to forecast employment and income by place of work and income by place of residence for each county assuming no change in status of the installation.[10] Of the many alternative techniques available to carry out this task, simple linear extrapolation was chosen for this study. The procedure involves estimating the parameters for three unique equations of the form

$$v_{it} = a_i + b_i * t \qquad \text{(A.32)}$$

Where v_{it} is either total employment or income by place of work or income by place of residence predicted for county i in the year the action is to occur t, and a_i and b_i are parameters.

When the forecasts are made, the standard error of the forecast for county i at time t is also calculated. This step is carried out automatically in the AFROI program for a user-specified level of confidence.

The remaining task is to compare the forecasted total employment and income for each county assuming no change in status of the military installation to the expected levels of activity given that a mission change takes place. A county is included in the ROI if the expected total employment or income assuming a mission change falls outside the confidence region surrounding the forecast line, in either the positive or negative direction.

[10]Currently, AFROI does not test the significance of place of residence employment impacts. This is due to the lack of an adequate data series to forecast this variable. The Bureau of Labor Statistics does produce these data, however, EIFS only has an historical series for the years 1976 to 1978. As additional place of residence employment data become available, the significance of these impacts can also be examined.

9.0. Summary

This paper has outlined a new approach for determining Air Force regions of influence (ROIs). The essential features of the model are summarized below.

(1) A boundary region is defined to encompass most of the direct and indirect impacts from an Air Force action. The boundary region may be defined as the BEA economic area surrounding the installation or an alternative approach, based on some maximum commuting distance, may be used to delineate the boundary region.

(2) The change in direct expenditures from a realignment is calculated from four sources: employees' wages and salaries, procurements, construction expenditures, and other programs.

(3) A generalized gravity-potential model underlies the entire ROI definition process. First, a gravity model is used to determine the initial distribution of direct expenditures from an AF activity when actual data on the place of residence of employees and location of vendors is not available. Second, this approach is used to assess how trading activity diffuses these direct expenditures to other counties in the boundary region. Finally, a variant of the basic gravity model is used to determine indirect employment and income impacts by place of residence.

(4) Both place of work and place of residence impacts are estimated for total employment and income for each county. These impacts are adjusted, as necessary, to reflect total changes for the entire boundary region. The additional impacts, if any, are distributed among all counties in proportion to the impacts already estimated for each county.

(5) Finally, a statistical test for determining which counties qualify for inclusion in the ROI is described. The approach taken compares forecasted employment and income in each county, assuming no change in status of the installation, to the level of activity

anticipated with a change of mission. If the activity plus or minus the change due to a realignment falls outside a user-specified confidence region, then the county is included in the ROI.

GRAVITY MODEL CALIBRATION USING THE AFROI PROGRAM

In the AFROI program, a default value of 2.0 is assumed for the friction of distance exponent β. Since the distance exponent typically varies in the range from 1 to 3 this value can be said to represent an average for all types of interaction.[11] However, there may be times when an analyst wishes to determine the value of β which most closely reflects the influence of distance on travel in a specific area. In these cases, β can be estimated or "calibrated" using an option provided in the AFROI program.

The calibration procedure uses existing information on the place of residence of AF employees, if available, to estimate the mean trip length for the journey-to-work. If this information is not available, the analyst can enter what he believes to be the mean journey-to-work distance.

The algorithm used to calibrate the β parameter is based on a second-order procedure developed by Hyman (1969). Stated simply, this approach begins with an initial value for β and the mean trip length and adjusts β up or down in a series of iterations until it comes to within some predetermined acceptable margin of error.[12]

The algorithm itself has two parts performed at different steps during the iterative procedure. If we let $\bar{t}$ equal the mean trip length, t_i the estimated trip length at iteration i, and β_i the value of β at iteration i, then at iteration 0 the new parameter value is

$$\beta_1 = \left(\frac{t_i}{\bar{t}}\right) * \beta_0 \qquad \text{(A.33)}$$

[11] See Isard (1960, pp. 508-509) and Huff (1973).

[12] A margin of error equal to 0.0001 is used in the AFROI version of this algorithm.

For all subsequent iterations, β is computed as

$$\beta_{i+1} = \frac{((\bar{t} - t_{i-1}) * \beta_i) - ((\bar{t} - t_i) * \beta_{i-1})}{t_i - t_{i-1}} \qquad \text{(A.34)}$$

This procedure usually converges after a few iterations.

In addition to the calibrated value for β, the AFROI program reports several goodness-of-fit measures including the correlation coefficient, root mean square error, and the sum of the absolute deviations which an analyst can use to judge how well the calibrated value of β represents the distribution of AF employees in a region.

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Appendix B

HELPFUL OPERATING PROCEDURES WITHIN AFROI

The UNIX and EIFS manuals describe the means for operating programs within the UNIX system. These techniques apply to AFROI and a few are described below for convenience.

Quit--By typing "quit" or "q" you may exit AFROI

Interrupt--if you wish to interrupt a long listing, such as those in Option 4, you may use your "RUBOUT" or INTERRUPT key or depress the CONTROL key and the letter "C" simultaneously. This will terminate the ongoing display and return you to the main menu.

Suspend--By depressing the CONTROL and "S" key simultaneously the output being displayed on the screen will be suspended. Type RETURN or CONTROL "Q" to restart output.

Return to Option Menu--By entering "-" the AFROI program will intercept and move you up one level in the menu hierarchy. Within ETIS, use Control "D" for the same effect.

All Information At several locations in the program you may request that the program print out all or part of the information in the option. By typing "*" the program will print out all information.

Appendix C

INPUT DATA QUESTIONNAIRE

********** REGIONAL INPUTS **********

Project: (U)_____

County where base is located: (U)_____

Year of completion of action: (U)_____

Regional employment multiplier: (E)_____

Regional income multiplier: (E)_____

Total number of affected personnel: (U)_____

# of affected personnel by class (U)
- Permanent military: _____
- Military trainees : _____
- Civil Service : _____
- NAF/BX : _____

Average wages of affected personnel (U)
- Permanent military: $ _____
- Military trainees : $ _____
- Civil Service : $ _____
- NAF/BX : $ _____

Dollar amount change in regional AF expenditures (U)
- Base Contracting (Services) : $ _____
- Base Contracting (Total) : $ _____
- Military Construction Program (MCP) : $ _____
- O&M Contract Construction : $ _____
- Non-Appropriated Fund (NAF) Construction : $ _____
- Military Family Housing (MFH) Construction: $ _____
- Other Construction : $ _____
- PL 81-874 Public School Program : $ _____
- CHAMPUS : $ _____
- Supplemental/Cooperative Care : $ _____
- Education Programs : $ _____
- All Other Programs (except BX) : $ _____

********** SYSTEM PARAMETERS **********

Working dependents full time equivalency factor: (A)_____

Fraction of working dependents (A)
- Permanent military: _____
- Military trainees : _____
- Civil Service : _____
- NAF/BX : _____

Fraction of AF employees living on-base
- Permanent military: (U)_____
- Military trainees : (U)_____
- Civil Service : (A)_____
- NAF/BX : (A)_____

Fraction of income spent in boundary region (on and off-base) (A)
  Permanent military: _____
  Military trainees : _____
  Civil Service   : _____
  NAF/BX   : _____

Fraction of income spent off-base by persons living off-base (A)
  Permanent military: _____
  Military trainees : _____
  Civil Service   : _____
  NAF/BX   : _____

Fraction of income spent off-base by persons living on-base (A)
  Permanent military: _____
  Military trainees : _____
  Civil Service   : _____
  NAF/BX   : _____

Fraction of construction expenditures for (A)
  materials: _____
  labor   : _____

Fraction of contracted service expenditures for (A)
  materials: _____
  labor   : _____

Fraction of BX sales from local suppliers: (A)_____

Gravity model exponent: (A)_____

Forecast confidence level: __% (A)

CPI price deflators (A)
  Base year: _____
  Inputs   : _____
  Outputs : _____

********** COUNTY INPUTS for >> (U)_____ << **********

Population: (E)____

Employment multiplier: (EU)_____

Income multiplier: (EU)_____

Number of affected personnel by class (U)
  Permanent military: _____
  Military trainees :   _____
  Civil Service   :   _____
  NAF/BX   :   _____

Change in expenditures (U)
  Base Contracting (Services)   : $ _____
  Base Contracting (Total)   : $ _____
  Military Construction Program (MCP)   : $ _____
  O&M Contract Construction   : $ _____
  Non-Appropriated Fund (NAF) Construction   : $ _____
  Military Family Housing (MFH) Construction: $ _____
  Other Construction   : $ _____
  PL81-874 Public School Program   : $ _____
  CHAMPUS   : $ _____
  Supplemental/Cooperative Care   : $ _____
  Education Programs   : $ _____
  All Other Programs (except BX)   : $ _____

Trade and service employment: (E)_____

Trade and service sales per worker: $ (E)_____

Trade and service income per worker: $ (E)_____

Service income per worker: $ (E)_____

Construction income per worker: $ (E)_____

Distance from installation: (U)_____

Distance between (E)_____ and

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

BEA employment by place of work (E)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

BEA total income by place of work (E)

_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____

BEA net income by place of residence (E)

_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____

DATA SOURCES: (U) USER, (A) AFROI, (E) AUTOMATICALLY TRANSFERRED FROM EIF:
(EU) TRANSFERRED BY USER FROM EIFS

Table D-1

PAYROLL FOR FY__

Personnel Classification	Number*	Annual Payroll ($000)* Total	Average
Military			
Permanent Party			
Trainees			
Total	____	____	____X
Civilian			
Civil Service			
Nonappropriated Fund			
Base Exchange			
Total	____	____	____X
Total Military and Civilian			X
Other			
On Base Private Business			
Contractors			
Total	____	____	____X

* (Identify whether the data is an annual average or a specific data)

Source:

Table D-2

PLACE OF RESIDENCE OF PERSONNEL (date)

County	Military				Civilian				Grand Total	
	Permanent Party	Trainee	Other	Total	Civil Service	NAF	BX	Total	No.	%
County X (where base is located)										
On-base										
Off-base										
County Y										
(etc.)										
Other										
Total										

Source:

Table D-3

CONSTRUCTION EXPENDITURES BY LOCATION OF CONTRACTORS HOME OFFICE ($000)

Location	MCP	NAF	MFH	O&M	(Other)	Total	%
County X							
County Y							
_____							
_____							
(etc.)	____	____	____	____	____	____	____
County total							
Other (name of state)							
Other U.S.							
Total	____	____	____	____	____	____	____
%							

_____

*(date of information)

Source:

Table D-4

CONSTRUCTION EXPENDITURE BY YEAR ($000)

Fiscal Year	MCP	NAF	MFH	O&M	(Other)	Total
_____						
_____						
_____						
_____						
(current yr)	___	___	___	___	_____	_____
Total						
Average annual						

_____

Source:

Table D-5

PROCUREMENT BY LOCATION OF VENDOR FOR FY __ ($000)

Location	Services	All Other	Total	%
County X (where base is located)				
County Y				
_____				
_____				
(etc.)	_____	_____	_____	_____
County Total				
Other (name of state)				
Other U.S.	_____	_____	_____	_____
Total				
%				

_____

Source:

Table D-6

MISCELLANEOUS EXPENDITURES (FY __)

Category	Location of Expenditure			
	County X	County Y	_____	_____
Payments to School Districts(a)				
(District A)				
(District B)				
_____				
(etc.) _____	_____	_____		
Total				
Health Care(b)				
CHAMPUS				
Supplemental and cooperative care				
Total	_____	_____		
Tuition assistance(c)	_____	_____		
Other Programs				
Total				

_____

Sources:

Appendix E

COMPUTER GENERATED MAPS

Overview

The capabilities of AFROI are enhanced through the aid of computer generated maps. The system described below permits the user to obtain maps of AFROI output for such activities as briefings, planning, and gaming with alternatives and for such documents as environmental assessments, environmental impact statements (EIS), and economic resource impact statements (ERIS).

The mapping system utilizes commercially available software driven by a personal computer. Such systems have been established at CERL and the AF Engineering Service Center (ESC), Tyndall AFB and maps can be provided on request, or an independent system can be established by the user.

The maps depict county lines and other information identified by the user. The counties can be shaded to highlight an ROI or AOI as well as intercounty socioeconomic variations, for example change in employment due to an action.

Applications

Because the system is flexible, maps can be designed to specific user requirements. For example, you can map the status quo (i.e., no action) conditions at an AF base and illustrate by county the number of AF employees or the amount of total AF spending, as well as breakdowns by spending categories: construction, payroll, procurement, and miscellaneous. The estimated change resulting from an action can also be mapped by county. The most important variables to be mapped include change in personal income and employment. This can be done with or without highlighting the ROI or AOI boundary.

Examples of AFROI maps for the Robins AFB test case described in Section 5 are depicted in Figures E-1 through E-6. Figure E-1 illustrates the place of residence of AF personnel as described in Table 5.2. Table E-2 shows the distribution of non-wage expenditures. AFROI was used to estimate the extent and location of employment generated by the operation of Robins. The results by place of work and place of residence are enumerated in Tables 5.8 and 5.9 respectively and illustrated in Figures E-3 and E-4 respectively. If the operations at Robins were to cease, the loss in total personal income by place of work and place of residence could be identified on Tables 5.8 and 5.9 and is presented in Figures E-5 and E-6 respectively.

PLACE OF RESIDENCE OF AF PERSONNEL
ROBINS AFB, GEORGIA

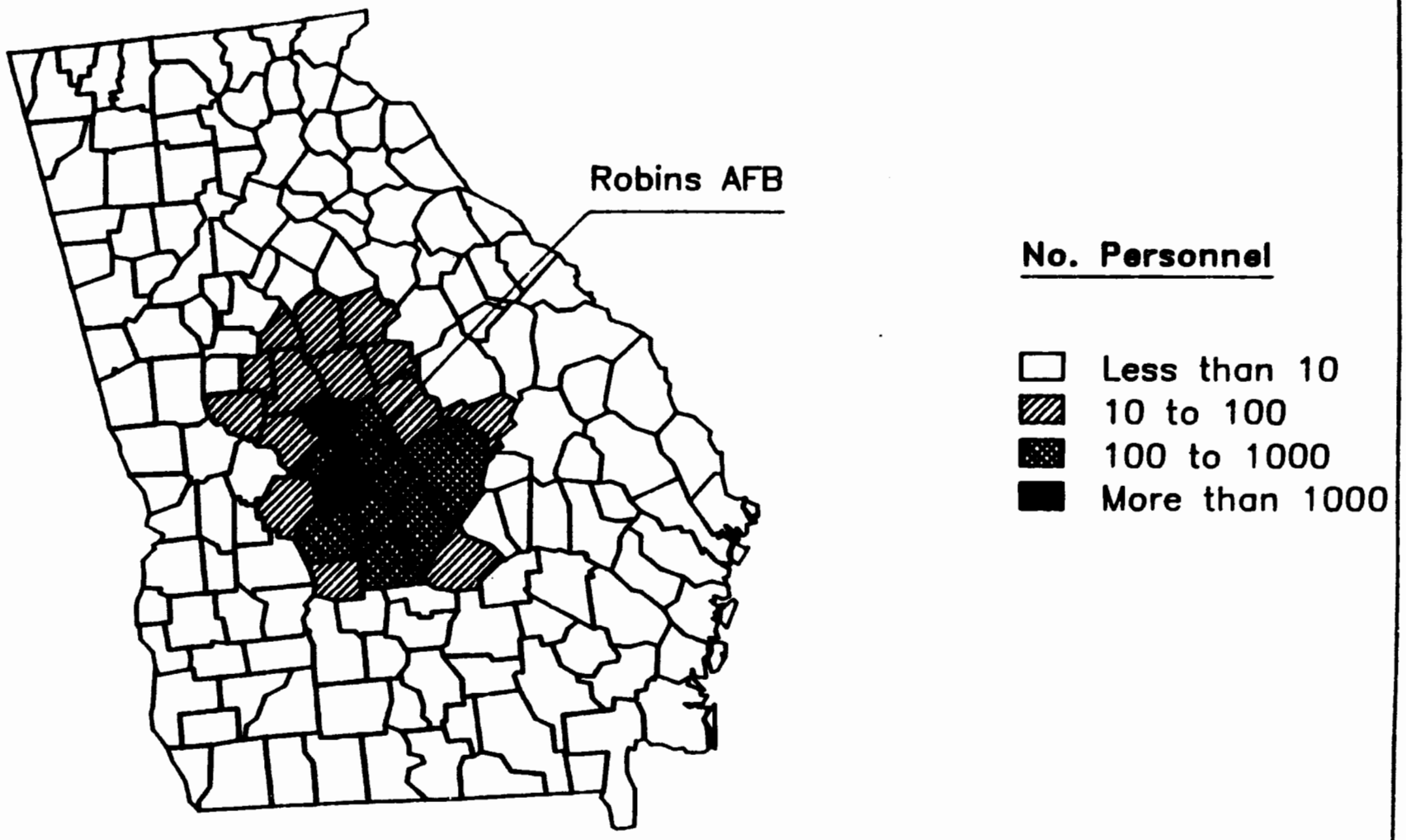


Figure E-1 Sample Map - Place of AF Residences

Distribution of AF Expenditures (Except Wages)
Robins AFB, Georgia

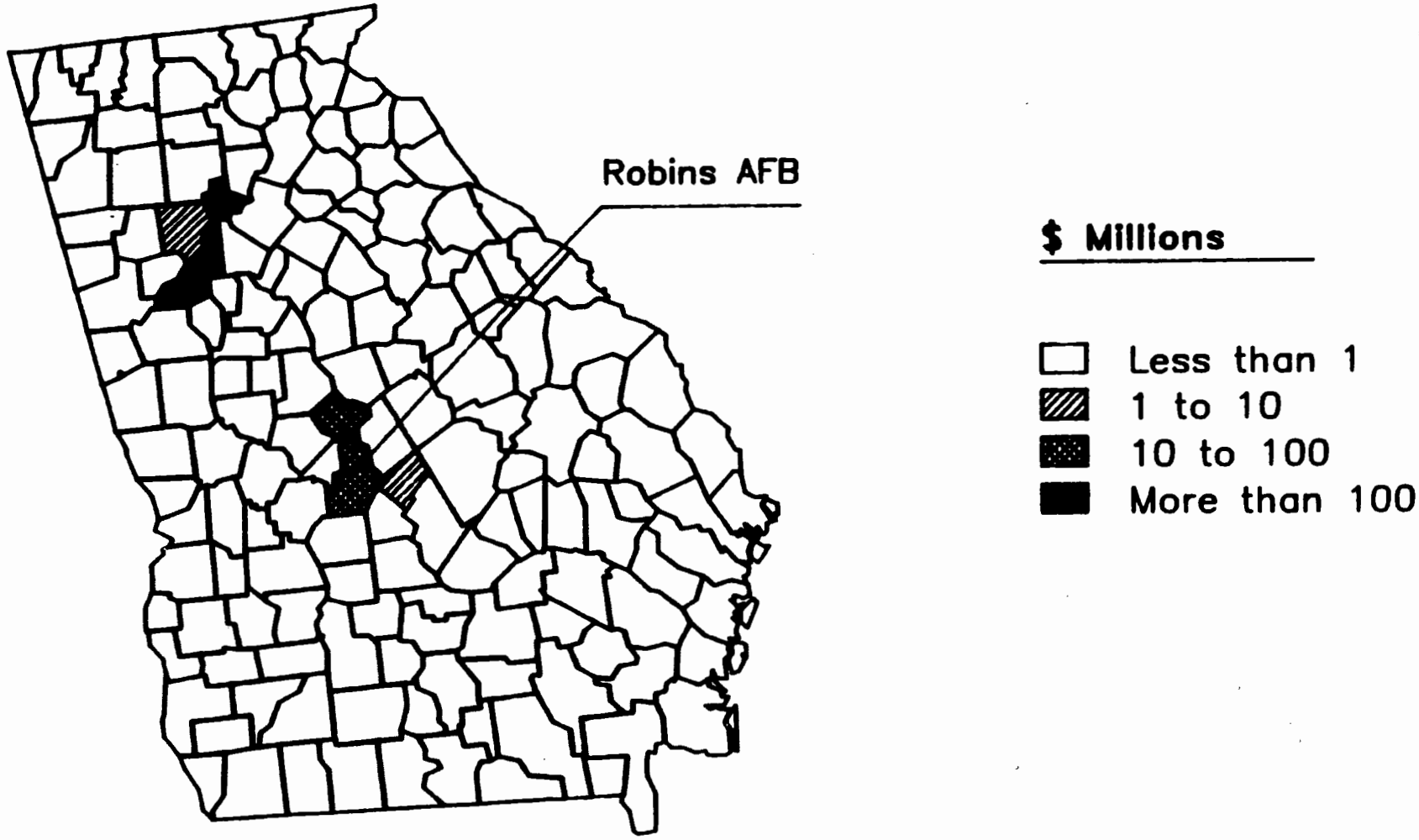


Figure E-2 Sample Map - Distribution of AF Expenditures

Robins AFB Region of Influence
Location of Employment Impacts

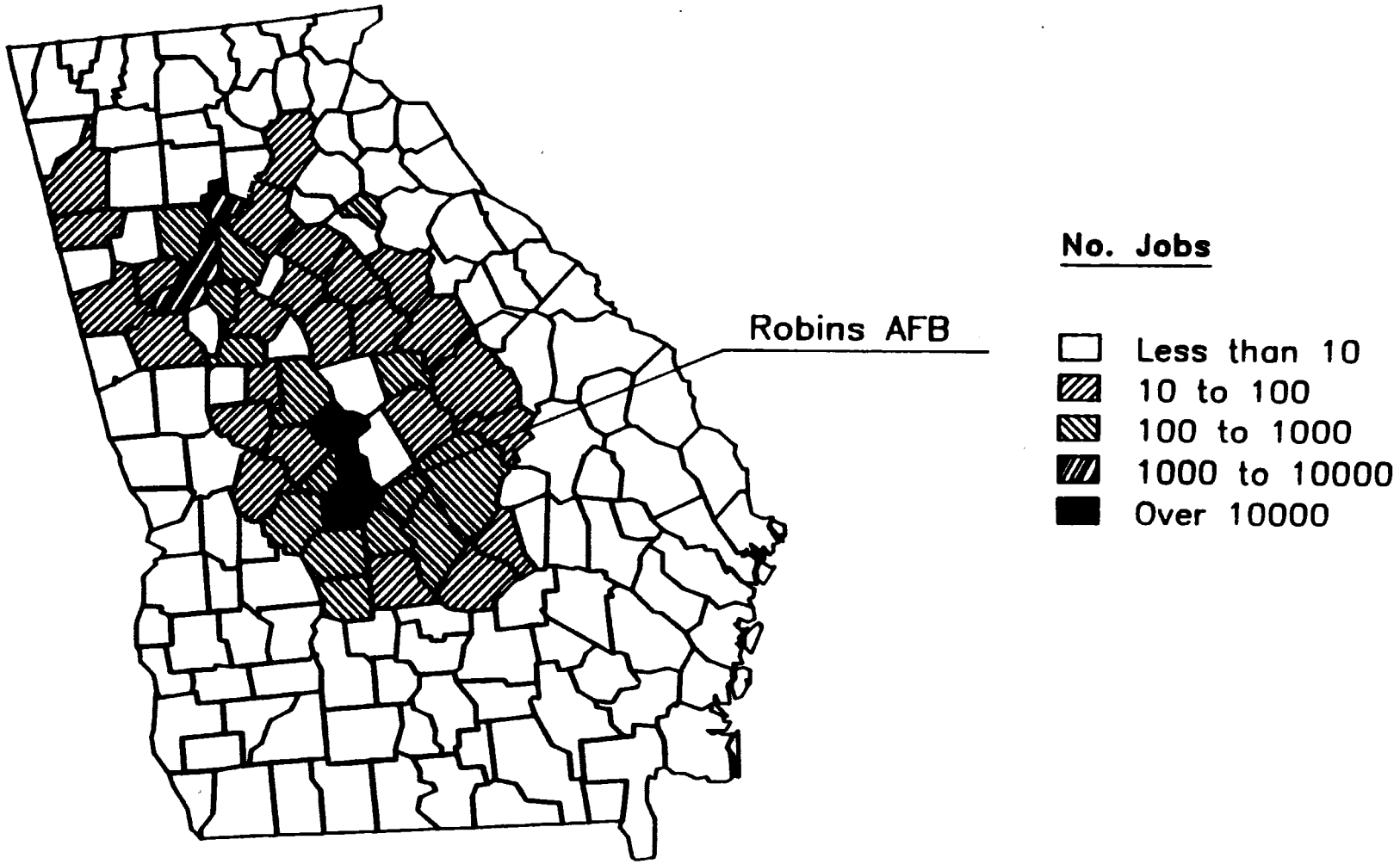
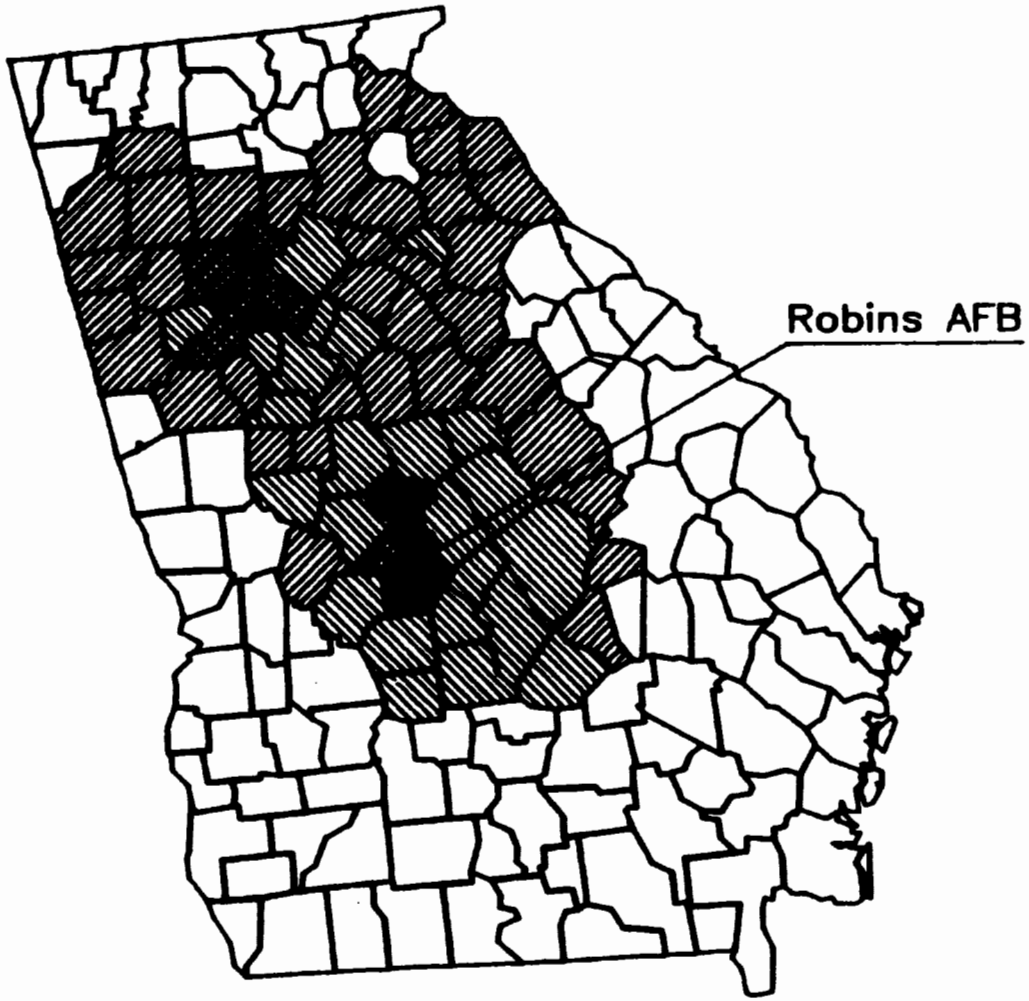


Figure E-3 Sample Map - Employment Generated by Place of Work

Total Place of Residence Employment Impacts
Air Force and Secondary Jobs Created
Robins AFB, Georgia



No. Jobs

- Less than 10
- 10 to 100
- 100 to 1000
- 1000 to 10000
- More than 10000

Figure E-4 Sample Map - Employment Generated by Place of Residence

Change in Place of Work Income Due to Action
Robins AFB, Georgia

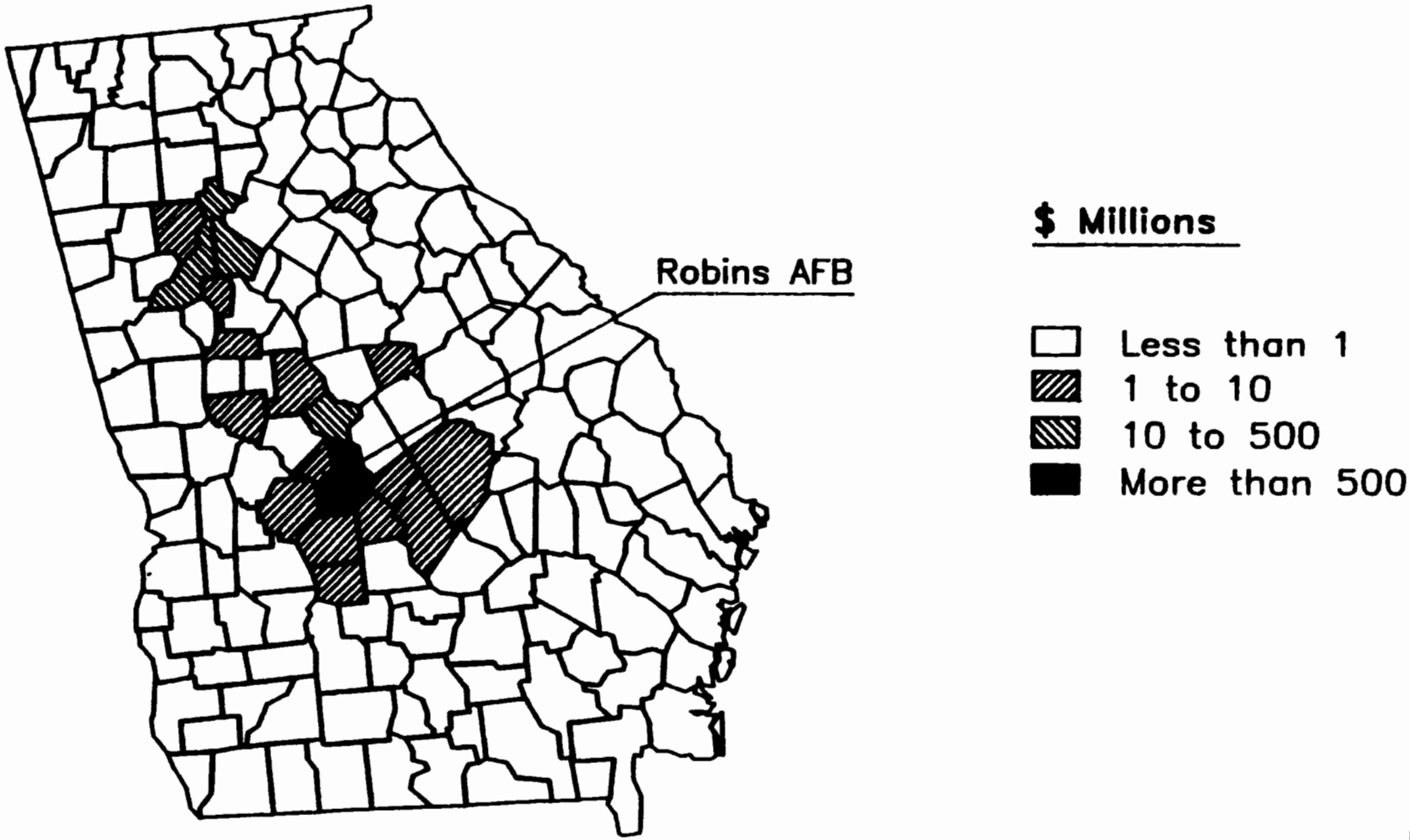


Figure E-5 Sample Map - Income Generated by Place of Work

Change in Place of Residence Income Due to Action

Robins AFB, Georgia

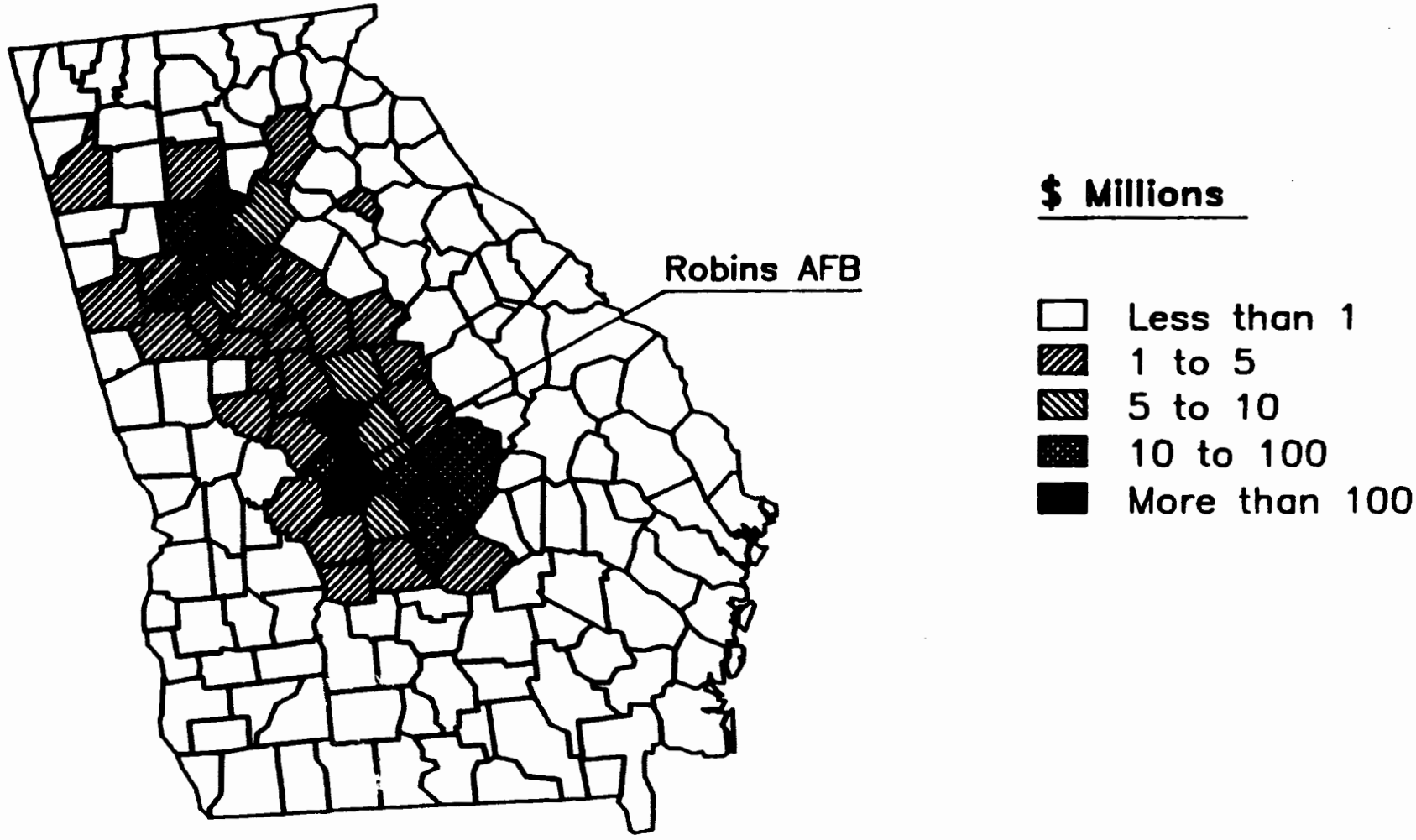


Figure E-6 Sample Map - Income Generated by Place of Residence

How to Use

To obtain maps generated at the ESC, contract Ms. Linda Merritt (AV Tel. No. 970-6253, commercial Tel. No. 904/283-6253, and CERL electronic mail address MERRITT). Provide her with your AFROI output and identify the information to be mapped. If desired, you can also specify ranges of value and other mapping criteria.

Alternatively, you can establish an independent system to generate maps. There is a variety of hardware and software combinations that can be used. Several were reviewed and the following system is recommended: MapMaster software, IBM AT or XT, color display monitor, and plotter. The software costs about $600 ($400 for the program and $200 for the county boundary file), and is available from Decision Resources, Inc. (commercial 303/222-1974). It takes about two hours for a first time user to set up, enter data, and start generating maps. Technical assistance to set up a mapping system can be obtained from Mr. Kim Bloomquist at CERL (commercial 217/352-6511 and CERL electronic mail address BLOOMQUI). Decision Resources provides assistance in setting up MapMaster.

This system is independent of the CERL ETIS. Thus, one must manually enter the AFROI data to be mapped into the personal computer system. The volume of data typically will be nominal, and this task can be accomplished in a relatively short period of time.

The MapMaster program, like other mapping software, contains a data base with the boundaries and names of all counties in the U.S. Working with menus, the user enters the data to be mapped and specifies shading patterns; the value range for shading; special symbols and information to be mapped (e.g., location of AFB); size and style of type face; and so forth. Depending on the capabilities of the plotter, high quality multi-color maps can be obtained from this system.

Future Changes to System

The long-term goal is to provide a mapping capability within AFROI. At the time that AFROI was initially developed, this was not deemed feasible. Alternative approaches were considered, and it was concluded that the currently recommended approach was preferable. It meets technical goals, is cost effective, and is highly flexible. Specifically, an independent system can be set up at the users' site, reducing dependence on other providers, the software is flexible and permits the user to customize maps, and as software (from Decision Resources or other vendors) is improved the system can be easily upgraded.

The AFROI mapping system will be modified in the future to reflect changes in software, the availability of software and hardware in the AF and at CERL, and the type and volume of demand for AFROI maps.

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