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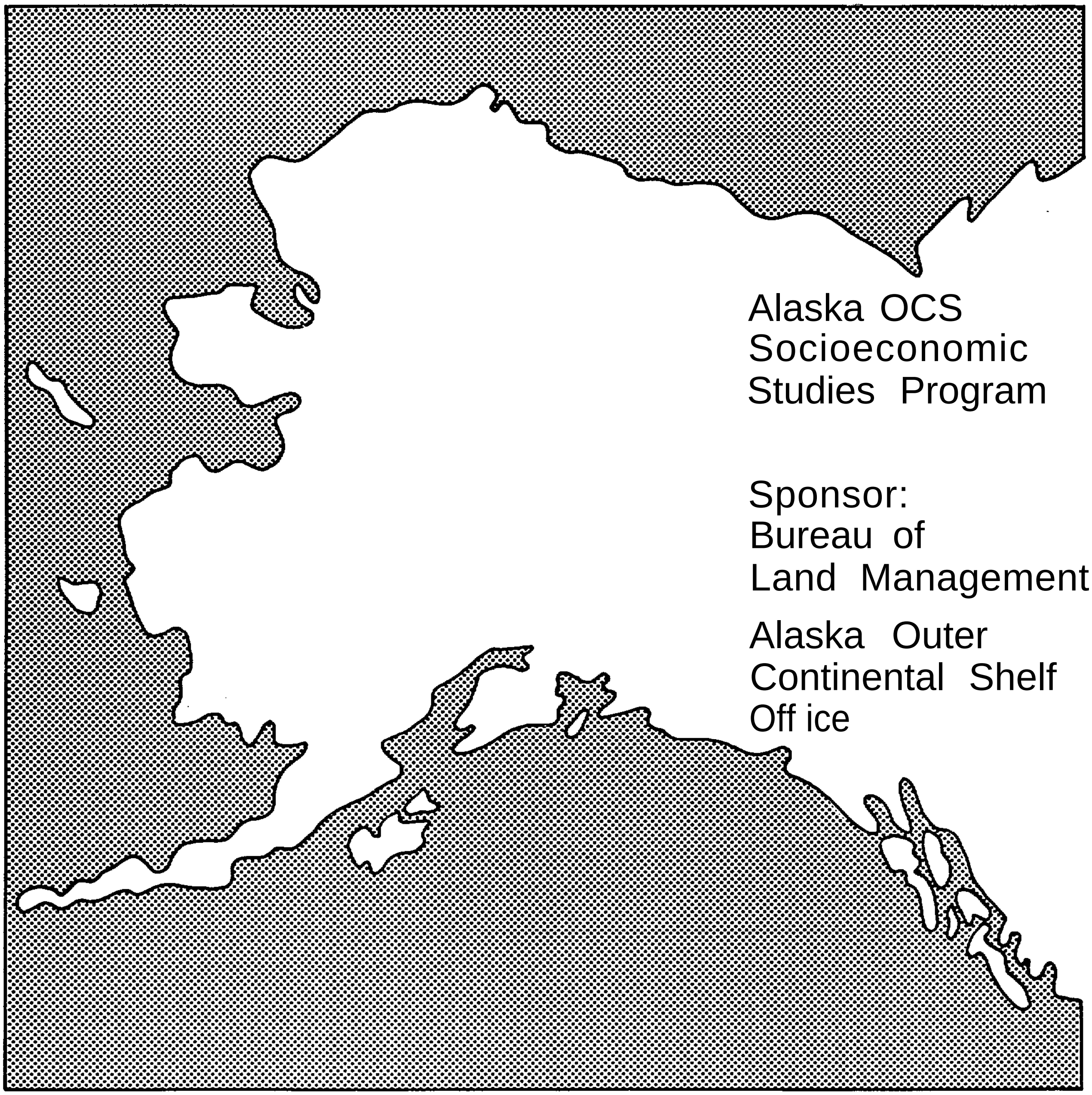
Number 18



Alaska OCS
Socioeconomic
Studies Program

Sponsor:
Bureau of
Land Management

Alaska Outer
Continental Shelf
Off ice

Beaufort Sea
Petroleum Development Scenarios
Economic and Demographic Impacts

The United States Department of the Interior was designated by the Outer Continental Shelf (OCS) Lands Act of 1953 to carry out the majority of the Act's provisions for administering the mineral leasing and development of off-shore areas of the United States under federal jurisdiction. Within the Department, the Bureau of Land Management (BLM) has the responsibility to meet requirements of the National Environmental Policy Act of 1969 (NEPA) as well as other legislation and regulations dealing with the effects of off-shore development. In Alaska, unique cultural differences and climatic conditions create a need for developing additional socioeconomic and environmental information to improve OCS decision making at all governmental levels. In fulfillment of its federal responsibilities and with an awareness of these additional information needs, the BLM has initiated several investigative programs, one of which is the Alaska OCS Socioeconomic Studies Program.

The Alaska OCS Socioeconomic Studies Program is a multi-year research effort which attempts to predict and evaluate the effects of Alaska OCS Petroleum Development upon the physical, social, and economic environments within the state. The analysis addresses the differing effects among various geographic units: the State of Alaska as a whole, the several regions within which oil and gas development is likely to take place, and within these regions, the local communities.

The overall research method is multidisciplinary in nature and is based on the preparation of three research components. In the first research component, the internal nature, structure, and essential processes of these various geographic units and interactions among them are documented. In the second research component, alternative sets of assumptions regarding the location, nature, and timing of future OCS petroleum development events and related activities are prepared. In the third research component, future oil and gas development events are translated into quantities and forces acting on the various geographic units. The predicted consequences of these events are evaluated in relation to present goals, values, and expectations.

In general, program products are sequentially arranged in accordance with BLM's proposed OCS lease sale schedule, so that information is timely to decision making. In addition to making reports available through the National Technical Information Service, the BLM is providing an information service through the Alaska OCS Office. Inquiries for information should be directed to: Program Director, Socioeconomic Studies Program, Alaska OCS Office, P. O. Box 1159, Anchorage, Alaska 99510.

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ALASKA OCS SOCIOECONOMIC STUDIES PROGRAM

BEAUFORT SEA PETROLEUM DEVELOPMENT SCENARIOS: ECONOMIC AND DEMOGRAPHIC IMPACTS

PREPARED FOR

BUREAU OF LAND MANAGEMENT
ALASKA OUTER CONTINENTAL SHELF OFFICE

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NOTICE

ALASKA OCS SOCIOECONOMIC STUDIES PROGRAM
BEAUFORT SEA PETROLEUM DEVELOPMENT SCENARIOS:
ECONOMIC AND DEMOGRAPHIC IMPACTS

Prepared by
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16. Abstract

Using the model of the Alaskan economy and population developed in the Man-in-the-Arctic Program of the Institute of Social and Economic Research, forecasts of the economic, fiscal, and population effects of four alternative petroleum development scenarios were made. The impacts of each of these scenarios is described in terms of change in aggregate indicators, causes of this change, the fiscal sector of the state, structure of the economy, composition of population, and the effect on three regions of the state.

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I. INTRODUCTION

Background

The progressive depletion of U.S. domestic petroleum reserves and increased concern over the reliability of foreign supplies have led to an increasing concern in the United States about future energy sources. The federal government has begun to establish policies aimed at increasing domestic energy supplies. The U.S. Outer Continental Shelf (OCS) has drawn considerable attention as a future source of petroleum supplies. These areas, because of their high potential as a source of oil and gas, figure importantly in the future energy program of the United States.

Historically, the role of Alaska in supplying energy has been small; total cumulative production in Alaska through 1974 was less than 1 percent of the U.S. total. Alaska has played a more important part in OCS production; petroleum production in the Upper Cook Inlet accounted for about 7 percent of cumulative U.S. Outer Continental Shelf oil production by the end of 1974 (U.S. Geological Survey, 1975). In the future, Alaska will be a much more important source of U.S. energy supplies. Production of oil at Prudhoe Bay and the potential oil and gas reserves in Alaska's OCS will increase its importance as a source of future U.S. energy resources.

Alaska accounts for over one-fourth of the identified oil and gas reserves in the U.S. The search for new domestic reserves will center importantly on Alaska, since it is estimated that more than one-third of all undiscovered recoverable domestic oil reserves are in the state. Alaska's importance in the OCS program is a result of the fact that over 60 percent of the undiscovered OCS reserves are in the Alaska OCS (U.S. Geological Survey, 1975). Projections estimate that by 1985 as much as 25 percent of total domestic crude oil production could be from Alaska (Federal Energy Administration, 1976).

Alaska's new role as a major U.S. energy supplier has already brought significant changes to the Alaska economy and soc' ety. The prospect of even further transformation looms large in the state's future as planned development extends to Alaska coastal waters. The first steps toward development of Alaska's coastal resources have already been taken with recent federal lease sales in the Northern Gulf of Alaska and Lower Cook Inlet. The next planned step involves the opening of the Beaufort Sea area to oil and gas development with a joint federal/state lease sale.

Changes produced by past petroleum development in the state have been major. The rapid changes in the Alaska economy and population associa-ted with development in Upper Cook Inlet and Prudhoe Bay have created strains on the Alaska society and environment. At the same time, these petroleum developments generated the most prosperous economic period in the state's history and produced prospects of continued prosperity throughout the next decade.

The nature of the changes induced by prospective new,developments, how-ever, will not necessarily resemble those characteristic of developments of the recent past. The technology, resource levels, and institutional arrangements surrounding the Beaufort development are subject to a wide range of uncertainty. Consequently, the implications of Beaufort Sea development for Alaskan economic and demographic processes can be accurately assessed only by an analysis which incorporates both these unique institutional and technological features, as well as the uncertainty surrounding them.

The objective of this report is to provide the information needed to anticipate the major dimensions of the economic and social impacts of proposed oil and gas developments in the Beaufort Sea. The Institute of Social and Economic Research, as part of the Bureau of Land Management's OCS Studies Program, has provided a series of economic and population forecasts through the year 2000 under several alternative scenarios for Beaufort Sea petroleum development. By contrasting these forecasts with a base case forecast, which does not include the proposed developments, it is possible to assess four major dimensions of the impacts of OCS development--population, employment, income, and state government fiscal impacts. This report will provide an assessment of these impacts.

The Structure of the Analysis

THE ROLE OF SOCIOECONOMIC FORECASTS

The uncertainty of the future, though it may increase the problems associated with making forecasts, increases the importance of these forecasts. Decision makers in both the public and private sectors need information about the future in order to plan their actions. The more uncertain the future events, the more important is some forecast of them. Forecasts serve two important purposes--they serve as a means of determining future demands and needs for services and they allow policy makers to test the alternative effects of various policies.

Two factors are important for making forecasts--knowledge of the forces affecting growth (exogenous variables) and knowledge of the relationship between these forces and growth. The description of these relationships is referred to as a model. Once the model is determined and a certain growth pattern for the exogenous variables is assumed, a forecast of the future levels of important variables can be made. Forecasts of the level of population and employment have been used to estimate the future needs for many public services, such as transportation and parks.

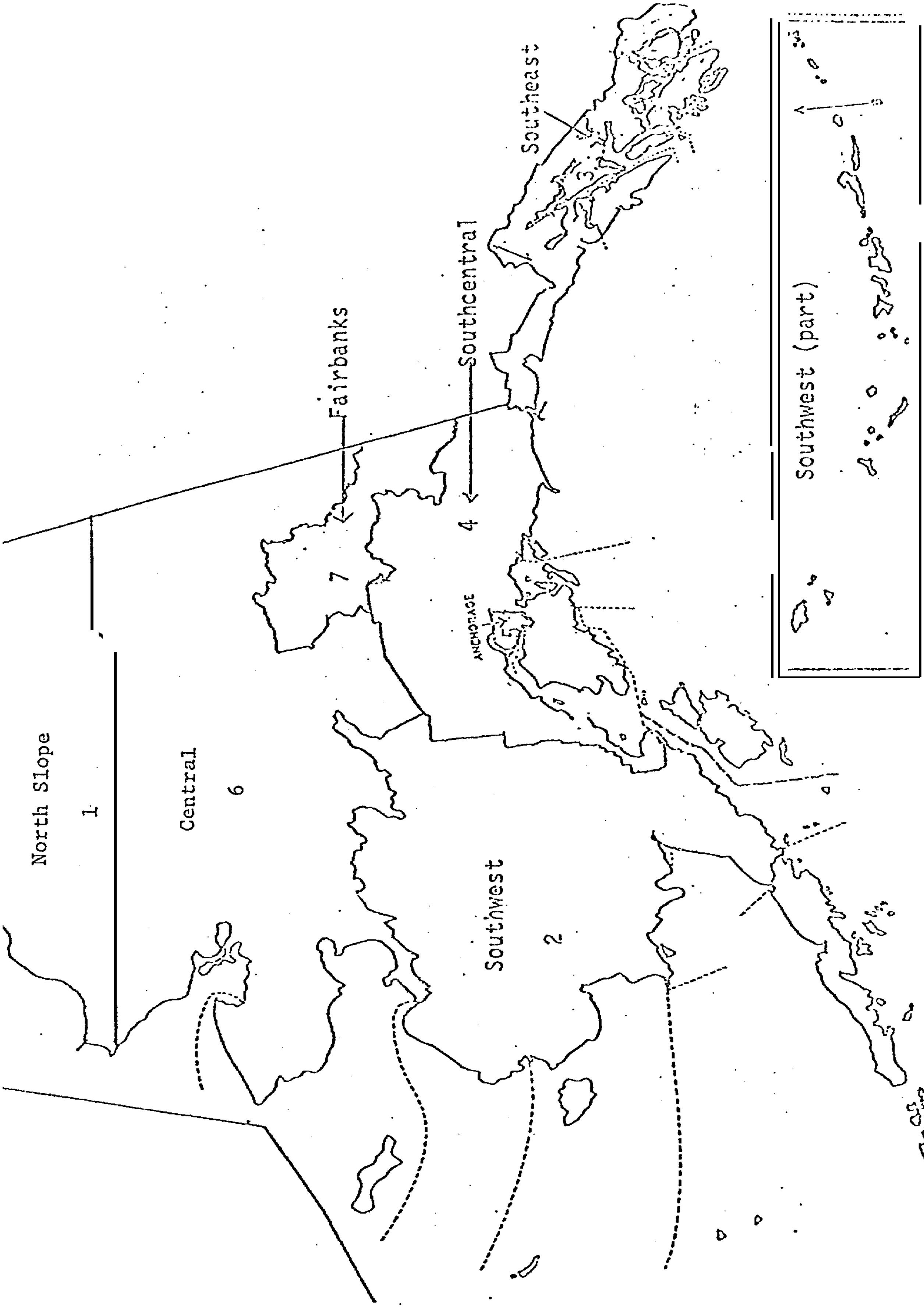
Models are also used to test the relative efficiency of alternative policy choices. When forecasting models explicitly include policy variables, such as tax rates, or variables directly affected by policy, such as the level of petroleum employment, they can be used to test the effects of policies described by these variables. By making separate forecasts under various assumptions about policy choices, the effects on important variables, such as population or employment, can be compared. Alternative policy choices can be compared in terms of their relative costs and benefits.

Forecasts used in the ways described above are useful for policy makers. They increase the information available to decision makers for making policy choices. Many present policy choices have important future implications which must be considered by policy makers. For example, current policy decisions regarding Beaufort Sea petroleum development will have their major effect in the middle of the next decade. By providing descriptions of the most probable future levels of important variables, socioeconomic forecasts serve as a framework for making policy choices.

METHODOLOGY

The methodology used to assess the impacts of alternative petroleum development scenarios in the Beaufort Sea OCS involves contrasting alternative forecasts of Alaska economic activity. An econometric model of the Alaska economy developed by the Man-in-the-Arctic Program (MAP) currently being conducted by the University of Alaska's Institute of Social and Economic Research is used to provide the analysis for the state and three of its regions--Anchorage, Fairbanks, and the North Slope.

The MAP model is an econometric model which describes the economy of the state and seven regions, shown in Figure 1.1 (Kresge, 1976). The model forecasts both economic and population variables. An econometric model is a mathematical representation of the important economic and demographic relationships. The mathematical expressions chosen for the model are those which best describe past historical relations. Use of an econometric model for making forecasts reduces the number of factors about which assumptions are required. Those factors not described by the model are known as the external, or exogenous, factors; assumptions about these factors drive the model.


North Slope
1
Central
6
Southwest
2
Fairbanks
7
Southcentral
4
ANCHORAGE
Southeast
Southwest (part)

Three models were developed for the Man-in-the-Arctic Program--an economic model, a fiscal model, and a demographic model; the output of the economic model is input to the demographic model. The models provide information for seven regions of the state. The model simultaneously estimates industrial output, employment, wages and salaries, and real disposable income. A key element of the model is the determination of industrial output, and determining relationships differ from one industry to another. The most important difference is whether output is determined by factors internal or external to the model. Assumptions about the external factors are needed input to the model. The assumptions used in this report describe a scenario. Once output is determined for each industry, employment is projected as a function of output.

The three components of population change are births, death, and migration; the demographic model treats each of these components differently. Estimates of births and deaths are derived from information about the population age and sex distribution, fertility rates, and mortality rates. Net migration is determined as a function of employment and real per capita income relative to the U.S. real per capita income. This relationship is statistically derived from historical information. The net sum of these components is used to determine state civilian population. State population total is allocated to the regions as function of regional employment. Total regional population is found by adding an estimate of the level of military in each region.

Because of the central role of the federal, state, and local government sectors in the determination of the overall level of economic activity, and consequently state migration, in Alaska, the third component of the MAP statewide model is devoted to an explicit modeling of the behavior of the government sectors in Alaska. The functions of the fiscal model within the larger MAP model are threefold: first, to calculate personal tax payments in order to derive disposable personal income from personal income; second, to provide a framework for the analysis of alternative choices for explicitly modeled policy variables; and finally, to provide the basis for estimates of state and local government employment which result from such policy choices. (A complete description of the MAP model is found in Appendix A.)

The use of models derived statistically from historical information to forecast future activity relies on some important assumptions. Most important of these assumptions is that past relationships will continue to hold in the future. This means that the model must be specified to account for any assumed structural changes which may occur. Models provide estimates of the level of activity but, because of their statistical nature, should not be considered to project exact levels of variables.

USE OF MAP MODEL FOR BEAUFORT SEA ANALYSIS

For the analysis of the proposed Beaufort Sea developments, five cases will be run using the statewide MAP model. In this section, we examine the sets of assumptions required for each case, or scenario, and the general methodology to be employed in the analysis of each scenario.

Assumptions Constituting a Development Scenario

A development scenario consists of a consistent set of hypothetical exogenous data assumptions which are used as input to the state model in order to test the consequences of hypothetical developments on the structure and performance of the Alaska economy. A development scenario consists of three major sets of assumptions--those related to exogenous employment, those related to exogenous revenues, and those related to state fiscal policy.

Exogenous Employment Assumptions. The first set of assumptions involves estimates of employment in the exogenous sectors of the statewide model. For petroleum and gas development scenarios, this usually is limited to direct employment in the mining (petroleum) sector and related employment engaged in facility construction. However, certain types of developments may require exogenous components of employment to be added to other exogenous, or even endogenous, sectors. Normally, however, data requirements consist of direct construction and petroleum sector employment by year for the life of the field.

Exogenous Revenue Assumptions. The second set of assumptions necessary for the construction of a development scenario deals with the exogenous components of state and local revenues. For petroleum and gas developments such as those to be examined in the Beaufort Sea, these assumptions consist of annual series of field production estimates, severance tax rates, value of field equipment and facilities, and distribution of reserve ownership among the state, federal, and Native owners.

They result in estimates of state and Native royalty payments, bonus payments, and severance taxes, which are then used as input to the fiscal model.

State Expenditure Policy. The final set of assumptions necessary for a development scenario are concerned with the expenditure rules adopted by the state government. These rules consist of a savings rate or a spending rule, as well as an annual capital expenditures series in addition to a set of tax cut variables where appropriate.

General Methodologyy for OCS Analysis

The general approach to be pursued in the analysis of OCS impacts will be as follows: Initially, a scenario will be developed containing no Beaufort Sea OCS development. This scenario will be run using the MAP model for purposes of comparison with each of the OCS scenarios. Each of the four Beaufort development scenarios will then be run. Each run will then be compared with the base run, examining the impact of the hypothetical development on four dimensions of the Alaska growth process--population, incomes, employment, and state and local government fiscal position.

Overview

The remainder of this report will describe the use of this econometric model to estimate the impacts of various alternative Beaufort Sea development scenarios. Part II presents the forecasts of economic activity in a base case which includes no offshore activity in the Beaufort Sea. Part

III then turns to a description of the alternative scenarios for Beaufort Sea development and the impact of these scenarios on each of the four dimensions presented earlier, Part IV then attempts to capture the uncertainty attached to these estimated impacts by examining the sensitivity of the conclusions of Part III to several of the most uncertain elements in the scenarios. Finally, Part V summarizes our major findings.

II. NON-OCS BASE CASE

Introduction

Development of the petroleum resources in the Beaufort Sea will result in changes to the Alaska economy. Petroleum development will affect both the structure and size of the economy. Changes in the level of economic activity which result from the development of the Beaufort Sea OCS can be defined as an impact of this development. Beaufort Sea petroleum development will impact the Alaska economy in two ways. First, the direct effect of OCS development occurs because of increases in construction and petroleum employment. Increases in employment and incomes lead to increased demand for goods and services and labor, leading to growth in the economy. Secondly, OCS development indirectly leads to growth by increasing the revenues to the state government. However the state government chooses to spend these extra revenues will lead to growth in the economy. State expenditures increase employment and incomes and lead to growth in much the same way as changes in mining employment. The sum of these changes, both direct and indirect, which results from OCS activity is the impact of development.

The impact of OCS development must be described as changes from a certain pattern of economic growth which would occur without this development. The purpose of this chapter is to describe the base case from which the impacts of OCS development will be measured. The impact of Beaufort Sea OCS development will be examined for a forecast period between 1977 and 2000.

The base case scenario consists of three major components--assumptions regarding levels of employment in the petroleum sector, the exogenous component of the construction sector, and other exogenous sectors, assumptions regarding oil and gas revenues to state and local governments, and an assumed rule for the determination of state and local government expenditures. This chapter begins with a description of these assumptions which define the scenario. The growth of the Alaska economy and population which results because of these base case assumptions is described in the last section of the chapter.

General Development Pattern

The basic premise on which the base case scenario depends is that very little oil and gas or other mineral development beyond that implied by current commitments occurs in Alaska. These current commitments include Prudhoe Bay and several fields surrounding Prudhoe, Upper Cook Inlet, Northern Gulf of Alaska OCS, and Lower Cook Inlet OCS, as well as existing coal and other mineral development. At Prudhoe Bay, it is assumed that currently proven reserves are augmented by discoveries in the Lisburne and Kuparuk formations. This production is assumed to lead to a maximum flow of 1.785 million barrels of oil a day through the TAPS line in 1985 (Dames and Moore, 1978). No significant new reserves are discovered in the Upper Cook Inlet, so that production there continues to decline over the forecast period. In the Northern Gulf of Alaska, it is assumed that resource discoveries are minimal, although in Lower Cook Inlet it is assumed that the mean levels of estimated recoverable reserves are in fact discovered and produced.

Exploration of NPR-4 is assumed to result in no commercial discoveries, and other mineral development activity is assumed to remain at current levels. With regard to major construction projects during the forecast period, it is assumed that work on the TAPS line is completed on schedule and that the Alcan gas pipeline is constructed between 1979 and 1983.

This scenario, while representing a consistent and plausible development pattern, should not be construed in any sense as a "best guess" of developement likely to occur in Alaska during the forecast period. The actual pattern likely to occur is subject to an enormous amount of uncertainty concerned with technology, market prices, federal policies, and so on. To forecast any specific development path as most likely would at this point be little more than idle speculation. Rather, the MAP model is designed to permit the formulation of ranges of scenarios which encompass these uncertainties in order to trace out the range of possible outcomes from alternative developments and policies. This base case should be regarded as a very conservative development pattern which includes only activities to which current commitments have been made.

EXOGENOUS EMPLOYMENT

The exogenous sectors of the Alaska economy are the petroleum sector, a portion of the construction sector, the manufacturing sector, federal government, and the agriculture, forestry, and fisheries sector. Employment in each of these sectors is determined outside of the model. Exogenous employment estimates for mining and construction will vary by development scenario and will be discussed in this section. Employment in both of these sectors is influenced by the general development pattern discussed above.

Table 2.1 shows the yearly assumed level of mining employment by project. (The regional distribution of this employment is shown in Tables B.1-B.3 in Appendix B.) Fair y high levels of exogenous mining employment are maintained throughout the forecast period. Mining employment reaches a peak of 6,548 in 1981 and declines slowly until 1990, when it stabilizes at 4,471. This level is maintained until 2000 These initial high levels of employment result from the staggered development of fields in the Northern Gulf, Lower Cook Inlet, and the L sburne and Kuparuk fields near Prudhoe.

The exogenous construction employment is shown in able 2.2. (The regional distribution of this employment is shown in Tables B.4-B.6 in Appendix B.) The major employment impacts of the " APS line are over after 1977, when employment drops from 5,775 to 90(O in 1978. Construction of facilities associated with petroleum development and production in the Northern Gulf and Lower Cook Inlet add small amounts of employment throughout the 1980s; the maximum level of construction employment for these projects is 551, which occurs in 1981. The major event influencing the level of exogenous construction is the construction of the Alcan gas line between 1979 and 1982. At its peak, construction employment on this project reaches 8,942 in 1980.

TABLE 2.1. STATEWIDE MINING INDUSTRY EMPLOYMENT
-BASE CASE-
(Thousands of Persons)

Year	Upper Cook Inlet[1]	Prudhoe Bay[2]	TAPS[2]	Other Prudhoe[3]	N. Gulf Ocs[4]	L. Cook Ocs[4]	ALCAN[5]	Other Mining[6]	Total
1977	.575	1.500	.000	.055	.740	.000	.000	1.694	4.564
1978	.575	1.100	.300	.055	1.283	.255	.000	1.694	5.262
1979	.575	.900	.300	.874	1.298	.638	.000	1.694	6.279
1980	.575	.600	.300	.923	.799	1.107	.096	1.694	6.094
1981	.575	.600	.300	.619	.534	1.130	.096	1.694	6.548
1982	.575	.600	.300	.710	.429	.732	.096	1.694	6.136
1983	.575	.500	.300	.801	.355	.562	.096	1.694	5.883
1984	.575	.500	.300	.892	.319	.623	.096	1.694	5.999
1985	.575	.450	.300	.983	.207	.604	.096	1.694	5.909
1986	.575	.450	.300	2.074	.211	.545	.096	1.694	5.945
1987	.575	.450	.300	1.814	.211	.411	.096	1.694	5.551
1988	.575	.450	.300	.948	.211	.417	.096	1.694	4.691
1989	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1990	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1991	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1992	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1993	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1994	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1995	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1996	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1997	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1998	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
1999	.575	.450	.300	.728	.211	.417	.096	1.694	4.471
2000	.575	.450	.300	.728	.211	.417	.096	1.694	4.471

[1]Author's estimate based on existing mining employment.

[2]Based on estimates in Issues in Alaska's Development (Kresge, et al), Table B-1.

[3]Author's estimates based on reserves and development schedules in "Developing Production and Price Estimates for Northern Alaska Oil and Gas Supplies" (Resource Planning Associates, 1975).

[4]Based on low scenario of Northern Gulf and moderate scenario for Lower Cook in "The Economic Impact of Federal Energy Development on the State of Alaska" (Porter, 1977).

[5]Author's estimate based on "Application of Alcan Pipeline for Certificate of Public Convenience and Necessity" to the Federal Power Commission, July 1976.

[6]Residual in statewide mining employment in 1976, assumed to remain constant through 2000.

TABLE 2.2. STATEWIDE EXOGENOUS CONSTRUCTION EMPLOYMENT, BY PROJECT
-BASE CASE-
(Thousands of Persons)

Year	TAPS[1]	ALCAN[2]	N. Gulf OCS[3]	L. Cook OCS[3]	Total
1977	5.775	.000	.000	.000	5.775
1978	.900	.000	.017	.000	.917
1979	.300	3.271	.077	.000	3.648
1980	.000	8.942	.107	.027	9.076
1981	.000	7.482	.257	.294	8.033
1982	.000	.390	.192	.365	.947
1983	.000	.000	.022	.284	.306
1984	.000	.000	.011	.099	.110
1985	.000	.000	.000	.444	.444
1986	.000	.000	.000	.426	.426
1987	.000	.000	.000	.000	.000
1988	.000	.000	.000	.000	.000
1989	.000	.000	.000	.000	.000
1990	.000	.000	.000	.000	.000
1991	.000	.000	.000	.000	.000
1992	.000	.000	.000	.000	.000
1993	.000	.000	.000	.000	.000
1994	.000	.000	.000	.000	.000
1995	.000	.000	.000	.000	.000
1996	.000	.000	.000	.000	.000
1997	.000	.000	.000	.000	.000
1998	.000	.000	.000	.000	.000
1999	.000	.000	.000	.000	.000
2000	.000	.000	.000	.000	.000

[1] Author's estimate.

[2] Author's estimate based on "Application of Alcan Pipeline for Certificate of Public Convenience and Necessity" to the Federal Power Commission, July 1976.

[3] Based on scenarios in "The Economic Impact of Federal Energy Development on the State of Alaska" (Porter, 1977).

OIL AND GAS REVENUES

For oil and gas developments on state lands and in coastal waters within three miles of shore, oil and gas production generates four types of state revenues--bonuses, property taxes, royalties, and severance taxes.

Bonuses are initial lump sum payments for drilling and production rights on state property. Bonuses are determined by the bids of oil companies and reflect their assumptions about the present value of the field. Inasmuch as all state-owned developments in the base case occur on tracts already leased, no new bonuses are paid during the forecast period.

Property taxes are based on the value of real property in oil and gas production, such as production and transportation facilities. Table 2.3 presents the amounts of property tax payments, assumed for the base case. Property tax revenues begin to decline in 1985 because production at Prudhoe and the value of the property begin to decline.

Royalties and severance taxes reflect the production value of a field. Royalties are the state's share of production, which is fixed in the terms of the lease. Severance taxes are taxes set by the state on the companies' portion of production. Both royalties and severance taxes are based on the wellhead value of oil and gas production on state properties, where wellhead value is defined as refinery price less transport costs. Thus, before estimating either royalties or severance taxes, it is necessary to make several assumptions to determine the appropriate wellhead values and production quantities on which taxes are levied. The oil and

TABLE 2.3. OIL AND GAS PROPERTY TAX PAYMENTS
-BASE CASE-
(Millions of Dollars)

Year	Total
1977	122.0
1978	168.3
1979	170.6
1980	193.2
1981	226.7
1982	251.8
1983	257.0
1984	261.4
1985	295.9
1986	281.1
1987	267.0
1988	253.7
1989	241.0
1990	229.0
1991	217.5
1992	206.6
1993	196.3
1994	186.5
1995	177.2
1996	168.3
1997	159.9
1998	151.9
1999	144.3
2000	137.1

SOIJRCE: Alaska Department of Revenue, internal memorandum, December 1977.

gas production totals from state lands and coastal waters assumed for the base case are shown, by site, in Table B.7 in Appendix B. The assumed wellhead values for North Slope oil and gas are presented in Table B.8 in Appendix B.

Royalty payments are set at 12.5 percent of the wellhead value of oil and gas produced on state property. Royalty payments for the base case are presented, by site, in Table 2.4.

Severance taxes are set at a maximum of 12.25 percent of the wellhead value of non-royalty oil and 10 percent of the wellhead value of non-royalty gas. Base case estimates of severance tax revenues, by site, are presented in Table 2.5.

STATE EXPENDITURE POLICY

Because of the central role of state and local government in the Alaska economy and because the behavior of these governmental units depends largely on policy choices to be made over the next several years within a framework far different from that of the past, the treatment of expenditures by state and local governments is a central feature of any development scenario to be considered.

Over the forecast period, state government will receive revenues from oil development which far exceed current levels of expenditures. The rate at which state government chooses to spend these revenues and the composition of these expenditures will serve to determine not only direct employment in the government sector, but, through the multiplier effects of such expenditure, will have impacts on all of the endogenous sectors, affecting the growth of employment, incomes, and prices and also serving to induce or retard new immigration into the state.

Two factors determine the current framework in which state expenditure policy will be determined. First, the revenues from the state will increase tremendously with the completion of construction of the Trans-Alaska Oil Pipeline. State revenues will be increased by both royalties and severance taxes from the Prudhoe oil fields (see Tables 2.4 and 2.5). Secondly, the establishment of the Permanent Fund will place new constraints on the use of certain petroleum revenue. In 1976 Alaska adopted a constitutional amendment which established the Permanent Fund. The relevant section of the constitution is Article IX, Section 15, which reads:

> Section 15. ALASKA PERMANENT FUND. At least twenty-five percent of all mineral lease rentals, royalties, royalty sale proceeds, federal mineral revenue sharing payments, and bonuses received by the State shall be placed in a permanent fund, the principal of which shall be used only for those income producing investments specifically designated by law as eligible for permanent fund investments. All income from the permanent fund shall be deposited in the general fund unless otherwise provided by law.

The establishment of the permanent fund removes a minimum amount of certain petroleum revenues from state spending.

These changes in the structure of state spending limit the usefulness of past spending policies in determining the spending rules to be used.

TABLE 2.4. STATE ROYALTY REVENUES
-BASE CASE-
(Millions of Dollars)

Year	Upper Cook Inlet[1] Gas	Upper Cook Inlet[1] Oil	Prudhoe Bay and Vicinity[2] Gas	Prudhoe Bay and Vicinity[2] Oil	Total
1977	4.0	36.0	.09	60.1	100.2
1978	4.4	33.1	.13	210.0	247.6
1979	5.4	31.3	.15	368.5	405.4
1980	6.9	29.5	.16	439.7	476.3
1981	8.3	27.9	.88	500.0	537.1
1982	9.0	26.4	1.35	544.9	581.7
1983	9.1	24.6	24.30	638.8	696.8
1984	9.3	22.9	25.90	794.1	852.2
1985	9.4	21.2	27.20	884.4	942.2
1986	9.4	19.9	27.20	842.2	898.7
1987	9.4	18.7	27.20	814.1	869.4
1988	9.4	17.6	27.20	859.4	913.6
1989	8.5	16.5	27.20	806.6	858.8
1990	7.7	15.5	27.20	732.3	782.7
1991	6.9	14.6	27.20	749.1	797.8
1992	6.2	13.7	27.20	748.0	795.1
1993	5.6	12.9	27.20	767.9	813.6
1994	5.0	12.0	27.20	606.1	650.3
1995	4.5	11.4	27.20	704.7	747.8
1996	4.1	10.7	23.10	665.9	703.8
1997	3.7	10.0	19.60	685.9	719.2
1998	3.3	9.4	16.60	645.9	675.2
1999	3.0	8.9	14.10	676.0	702.0
2000	2.6	8.3	12.00	628.1	651.0

[1] From "The Permanent Fund and the Growth of the Alaskan Economy" (Goldsmith, 1977), Table ?.3.

[2] Based on a rate of 10.5 percent of the wellhead value of production until the $500 million is contributed to ANCSA, then a rate of 12.5 percent of the wellhead value of production.

TABLE 2.5. STATE SEVERANCE TAX REVENUES
-BASE CASE-
(Millions of Dollars)

	Site				
	Upper Cook Inlet		Prudhoe Bay and Vicinity		
Year	Gas[1]	Oil[2]	Gas[3]	Oil[4]	Total
1977	2.0	36.0	.15	72.2	110.4
1978	2.3	33.1	.21	240.7	276.3
1979	2.8	31.3	.25	400.4	434.8
1980	3.6	29.5	.27	439.7	473.1
1981	4.4	27.9	1.47	500.0	533.8
1982	4.6	26.4	2.27	544.9	578.2
1983	4.7	24.6	40.82	615.3	685.4
1984	4.8	22.9	43.51	667.1	738.3
1985	4.9	21.2	45.61	742.9	814.6
1986	4.9	19.9	45.61	707.5	777.9
1987	4.9	18.7	45.61	677.4	746.6
1988	4.9	17.6	45.61	708.2	776.3
1989	4.4	16.5	45.61	658.2	724.7
1990	3.9	15.5	45.61	591.7	656.7
1991	3.5	14.6	45.61	605.3	669.0
1992	3.2	13.7	45.61	604.4	666.9
1993	2.9	12.9	45.61	620.5	681.9
1994	2.6	12.0	45.61	489.7	549.9
1995	2.3	11.4	45.61	569.4	628.7
1996	2.1	10.7	38.85	538.0	589.7
1997	1.9	10.0	32.97	548.7	593.6
1998	1.7	9.4	27.93	516.7	555.7
1999	1.5	8.9	23.73	540.8	574.9
2000	1.4	8.3	20.16	502.4	532.3

[1] From "The Permanent Fund and the Growth of the Alaskan Economy" (Goldsmith, 1977), Table C.3.

[2] Author's estimate assumed equal to royalties with inclusion of federal revenue sharing from production of federal properties.

[3] Author's estimate based on assumed gas severance tax of 6¢ per mcf.

[4] Author's estimate based on assumed severance tax of 11.5 percent of wellhead value to 1979 with it rises to 12 percent; after 1987 severance tax is assumed to fall until it reaches 11.4 percent of wellhead value by 2000.

However, examination of past spending provides some help in assessing a general pattern of response of state spending to increased revenues. Between 1960 and 1977 total state expenditures increased from $37 million to $893 million. The average annual growth rate in expenditures has been 25 percent after the receipt of Prudhoe Bay bonuses in 1969, while before the sale the rate of increase was 17 percent. Extremes have ranged from 2 percent between 1963 and 1964 to 59 percent between 1970 and 1971. The ratio of real per capita expenditures to real per capita income has also experienced rapid increases. This ratio had increased to 12 percent by 1969. After the Prudhoe lease sale, the ratio increased to 20 percent between 1969 and 1971. Since 1971 this ratio has remained close to 20 percent (Goldsmith, 1977). These spending patterns point to two possible conclusions. First, expenditures increase dramatically in response to large increases in revenues. Second, the level of real per capita expenditures once raised tends to remain at the new higher level.

The rate of state expenditures, because it is a matter of policy choice to be made within a framework far different from past experience, cannot be modeled simply from past relationships. Rather, it must be determined by a hypothetical expenditure "rule" which captures both the short- and long-run features of expenditure determination in the state. First, in the short-run, the establishment of a permanent fund into which a portion of royalty and bonus revenue will be deposited sets the framework for an expenditure rule which sets current expenditures equal to total revenues less permanent fund contributions. Under such a rule, the permanent fund contribution may vary between 25 percent and 100 percent of royalties and bonuses, but even if the rate approached 100 percent, the increased petroleum revenues due to severance and property taxes from Prudhoe Bay would result in substantial expenditure increases by the late 1970s and early 1980s, inducing employment growth. To sustain the levels of per capita expenditures implied by such a policy in the long-run as petroleum resources are depleted, however, will require eventually either the consumption of any accumulated balances or the imposition of substantial new tax programs, or both. The expenditure rule utilized for the present analysis attempts to capture both features of state expenditure policy--a fixed savings rate as petroleum revenues grow and an adjustment to such policy as revenues decline. As petroleum revenues grow, it is assumed that bonuses and 60 percent of royalties are deposited in the permanent fund and that current expenditures equal the remainder of current revenues. This represents a middle level of savings--between the extremes of 25 percent and 100 percent. As petroleum revenues eventually decline, it is assumed that the state maintains per capita expenditure levels by gradually reducing the savings rate to zero and eventually consuming the accumulated balance, Such a program would be sustainable into the early 2000s under the assumptions of the base case.

Local governments are more constrained by revenues than is the state government. Local government expenditures are assumed to equal revenues in most cases. The only exceptions are those governments in which some petroleum property is located. Alaska Statutes, Section 29.53.045, TAX ON OIL AND GAS PRODUCTION AND PIPELINE limits the rate municipalities can tax petroleum property to $1,500 for each resident. This rules is explicitly modeled for the North Slope Borough where it is assumed, based on the short historical period, that 75 percent of these revenues are spent on current expenditures.*

Admittedly, these expenditure rules are highly speculative, but they must remain so to adequately reflect the extremely wide range of policy choices open to state government as a consequence of new oil revenues. Rather than attempt to predict a specific expenditure path, the methodology used here is to assume this hypothetical path tentatively for the base case, measure impacts of OCS development from this base case, then test the sensitivity of these impact measurements to variations in this somewhat arbitrary expenditure pattern. This will be done in Chapter IV.

The Base Case

AGGREGATE INDICATORS

This section summarizes the growth of four aggregate indicators of economic activity--population, employment, personal income, and state expenditures--during the forecast period, 1977-2000. The 1977 levels in all tables are projections and will not necessarily agree with actual levels. They are shown in Table 2.6. Projections are based on average historical relationships between the projected variable and important exogenous variables. There are two reasons why projects in any year may differ from the actual levels. First, estimates of the level of important exogenous

*During the course of this study, the borough and the state agreed on an alternative formula allowed under this statute. See Alaska Statutes, Section 29.53.045(c).

TABLE 2.6. AGGREGATE INDICATORS OF BASE CASE GROWTH
STATE OF ALASKA
1977-2000

Year	Total Population (Thousands of Persons)	Total Employment (Thousands of Wage Earners)	Personal Income (Millions of $)	Total State Expenditures (Millions of $)
1977[1]	399,968	190,988	4,128.73	980.65
1978	402,357	187,828	3,947.64	1,231.14
1979	419,124	198,614	4,522.77	1,335.50
1980	449,203	218,532	5,561.03	1,562.77
1981	466,927	226,705	6,052.76	1,766.84
1982	463,198	218,665	5,709.98	1,987.56
1983	470,099	221,273	6,009.95	2,218.53
1984	479,525	226,057	6,440.03	2,434.07
1985	491,934	233,677	7,031.58	2,661.16
1986	500,022	237,789	7,506.67	2,803.24
1987	503,990	238,965	7,831.86	2,905.72
1988	504,373	237,918	8,066.80	2,983.78
1989	508,403	240,470	8,509.24	3,096.86
1990	512,526	243,351	9,008.42	3,215.68
1991	518,104	247,590	9,603.92	3,353.03
1992	522,414	250,882	10,186.70	3,483.52
1993	528,300	255,556	10,872.60	3,634.20
1994	533,322	259,544	11,561.30	3,782.37
1995	539,760	264,729	12,358.10	3,950.65
1996	545,167	269,062	13,151.70	4,114.77
1997	552,447	274,925	14,085.00	4,304.71
1998	558,855	280,025	15,026.30	4,493.02
1999	567,344	286,779	16,134.70	4,711.63
2000	575,574	293,209	17,289.00	4,935.70

[1]Projected value may differ from actual 1977 estimate.

SOURCE: MAP Statewide Model

variables may differ from the actual levels. Second, the relation between these variables may differ in any year from the historical average. In using such models for making projections, it is assumed that these relations, while they may not predict actual levels in any particular year, describe the general trend of future growth.

These indicators, shown in Table 2.6, illustrate economic growth throughout the period 1977-2000, which is less rapid than recent Alaska experience. Population growth averages approximately 1.6 percent annually throughout the period. This is moderate population growth when compared with the 6 percent annual population growth the state experienced between 1970 and 1975 (Al aska Labor Department, 1970-1975). Between 1977 and 2000, the base case shows a growth of 175,606 in population. More than half of this growth occurs before 1990.

The moderate rate of population growth can be attributed to a relatively slow increase in employment. Total employment grows at an annual average rate of 1.9 percent throughout the period. This rate is closer to that of the entire country, which averaged approximately 1.5 percent per year between 1955 and 1972, than to recent Alaska experience (U.S. Department of Labor, 1975). During the period between 1970 and 1975, employment in Alaska grew at a rate of 11.8 percent per year; between 1965 and 1970, employment grew approximately 6 percent per year (Alaska Department of Labor). In the base case, the state economy is importantly influenced by two events, the construction of the gas line route from Prudhoe Bay in 1979 and the decrease in petroleum-related employment after it peaks in

1980. These two events influence employment growth through the early part of the base case period. Employment increases to a peak of 226,705 by 1981, then falls about 3.5 percent in the following year with the winding down of the gas line project. It takes three years for the economy to pass this 1981 employment peak. The growth during the gas line construction period is more than a third of the total growth in employment during the base period. After 1984 the growth in employment is at an annual rate of 1.6 percent.

The level of personal income in the state determines the demand for goods and services, which affects the level of overall economic activity. In nominal dollars, which are not corrected for inflation, personal income increases by a factor of four by the year 2000. On average, personal income increases at a rate of approximately 6.4 percent a year throughout the period.

The other major determinant of economic growth is state spending. Because of the state expenditure rule assumed, state expenditures are governed by increases in state revenues. This is reflected by the rapid increase in expenditures in the early portion of the study period as the level of petroleum revenues increases. State expenditures increase at an average annual rate of 9.6 percent between 1977 and 1990; this rate slows to 4.4 percent annually for the remainder of the period. Nominal state expenditures increase by $3.96 billion between 1977 and 2000; the effect of inflation is to reduce the impact of these expenditures on the Alaska economy.

CAUSES OF GROWTH

The growth of the Alaska economy is influenced by three separate but interrelated factors, changes in the level of employment in the exogenous sectors of the economy, changes in the level of personal income, and changes in the level of state spending. Economic growth is directly affected by the employment created in the exogenous sector. The source of this growth is external to the Alaska economy; the most obvious recent example of this is the construction employment associated with construction of the Trans-Alaska Pipeline. The second major cause of growth is an increase in real disposable personal income. Increases in real disposable personal income increase the demand for goods and services which is reflected by increases in employment in the state economy. Personal income is affected by the growth of wage rates and the growth in number of wage earners. Because of this relation, personal income both affects and is affected by the growth of the economy. The third major cause of growth is state expenditures. State expenditures affect state growth in two ways--through capital expenditures on projects such as highways and ports, which increase the output of the construction industry, and through state government employment, which, because it increases wages and salaries, leads to increased demand and employment.

Each of these forces has a period in the base case in which it is important. Until 1982 growth of employment in the exogenous sectors of mining and construction plays an important role. The construction of the Alcan gas line and increased mining outside of Prudhoe Bay are important determinants of economic growth. Between 1977 and 1986 state expenditures are also expanding rapidly and importantly affect growth. After 1986 real per capita state expenditures are maintained at a constant level. The increase in revenues is no longer sufficient to support increases in the level of real per capita expenditures, so real state expenditures increase only with increases in population. After 1986 the main cause of growth is the continued expansion of personal income. The effects of each of these will be descr bed in the following section.

Characteristics of Growth

INCOME CHARACTERISTICS

Growth in personal income increases the demand for the goods and services produced in the economy and is an important factor in determining the growth of the Alaska economy. Throughout the base period, personal income is projected to increase approximately four times, at an annual average rate of over 6 percent. The full force of this growth in personal income is not translated through to the economy because of two factors. First, both federal and state taxes reduce the amount of income people can spend. Second, rising price levels reduce the impact of an extra dollar of income by reducing the amount of goods and services which it can buy. Table 2.7 shows the increase in income-related variables.

Progressive federal and state income tax schedules are assumed throughout the base period; taxes · ncrease their share of persona" income, from 23 percent to 28 percent, as personal income rises. This slight increase in the tax take reduces the rate of growth in disposable personal income to slightly below the rate of personal income. Price level increases are

TABLE 2.7. BASE CASE INCOME VARIABLES
STATE OF ALASKA
1977-2000

Year	Disposable Personal Income (Millions of $)	Real Disposable Personal Income (Millions of $)	Real Disposable Personal Income Per Capita
1977[1]	3,347.62	1,323.03	3,307.83
1978	3,215.15	1,234.09	3,067.14
1979	3,663.80	1,350.42	3,222.01
1980	4,483.11	1,571.33	3,498.04
1981	4,864.54	1,645.07	3,523.18
1982	4,616.80	1,532.92	3,309.43
1983	4,847.43	1,562.74	3,324.27
1984	5,191.75	1,621.30	3,381.06
1985	5,662.76	1,707.73	3,471.45
1986	6,026.91	1,762.13	3,524.10
1987	6,296.02	1,789.97	3,551.61
1988	6,474.25	1,793.85	3,556.60
1989	6,832.09	1,838.45	3,616.13
1990	7,211.29	1,883.95	3,675.80
1991	7,684.48	1,946.28	3,756.54
1992	8,125.40	1,997.35	3,823.30
1993	8,666.30	2,064.98	3,908.74
1994	9,185.54	2,122.95	3,980.63
1995	9,808.64	2,196.61	4,069.60
1996	10,404.40	2,259.50	4,144.59
1997	11,128.20	2,340.90	4,237.33
1998	11,832.10	2,412.31	4,316.52
1999	12,684.70	2,503.60	4,412.85
2000	13,544.30	2,588.93	4,497.99

[1] Projected value may differ from actual 1977 estimate.

SOURCE: MAP Statewide Model

more important in reducing the impact of personal income on growth. The real price level rises at an annual average rate of 3.2 percent for the period as a whole. Because of the slow growth in the Alaska economy, this increase is mostly a reflection of U.S. price increases. The increase in the price level has the effect of reducing the growth in disposable real personal income to less than half the rate of growth of disposable personal income. Real disposable personal income grows faster than does population, so that real per capita disposable personal income grows at an average annual rate of 2.9 percent throughout the period.

Real disposable persona income (DPIR) increases with increases in the average real income per worker and with increases in the number of workers. Average real income per worker is substantially made up of wages and salaries, so it reflects changes in the real wage rate. The real wage rate is affected by changes in the general wage rate because of price changes and overall changes in outside wages. The average real wage will also be affected by changes in the structure of employment; as high wage sectors such as construction and petroleum, increase their proportion of employment, the average real wage will rise. Throughout the forecast period, DPIR is affected by each of these factors.

Changes in the level of DPIR in the period 1977-1981 illustrate the importance of the high wage exogenous sectors; growth of DPIR is importantly affected by changes in the level of exogenous employment. DPIR falls by $89 mill ion after 1977, when the TAPS 1 ine is completed. It rises at an average rate of 5.6 percent per year between 1978 and 1981, primarily as a result of increases in exogenous employment. Because of the construction of the Alcan gas line, exogenous employment increases by about 8,000 during this period. The effect on DPIR is more than proportional because these employees are in the high wage construction sector. The effect of these high wages can be seen by looking at real per capita disposable personal income, which rises to a peak of $3,523 with the peak in gas line employment. During this same period, increasing state expenditures are leading to expansion of state employment and construction employment. This effect maintains the growth in DPIR. After 1985 real state expenditures are increasing at a rate equal to population growth, and exogenous mining employment continues to fall; both of these have dampening effects on the growth of DPIR, which grows at an annual rate of 2.6 percent during the period 1985-1990. Exogenous mining employment stabilizes in 1990; growth during the remainder of the forecast period is at an average rate of 3.2 percent annually. Growth in DPIR is a result of increases in employment and the wage rate. This leads to growth in DPIR, which is greater than proportional to increases in employment.

Real wage rates increase after 1990 as a result of increases in the U.S. real wages. The U.S. labor markets affect the real wage rate in Alaska because of the small size of the Alaska labor market and the mobility of Alaska workers. These factors lead to outmigration as the equilibrating factor, which maintains the relation between Alaska and U.S. real wages. The slowing of the Alaska economy leads to outmigration and a reduction in the supply of labor and not to a reduction in the relative Alaska wage differential.

FISCAL CHARACTERISTICS

Revenues

Revenues, expenditures, and fund balances are shown in Table 2.8. Total revenues rise throughout the base period until 1989, when they peak, then fall by $55.59 million and begin to rise again. The rise in total revenues is rapid throughout the 1980s because of the revenues generated from the petroleum sector and interest earned on the unspent general and permanent fund balances. By 1986 petroleum revenues have peaked, and they decline throughout the remainder of the period. After 1988 earnings from the general fund also begin to decrease. Overall, revenues follow two periods: prior to the peak in 1989, revenues grow at an annual average of 9.3 percent a year; after this peak, they increase at less than 1 percent annually.

The most important sources of revenue are non-petroleum taxes, petroleum revenues, and interest from the fund balances. Taxes fall in the second year of the base case with the completion of the TAPS line because of the general decline in economic activity and the decline in personal income. They rise to peak at $257.08 million prior to the end of the gas line construction in 1981. After that, they grow approximately 5.6 percent each year. These cycles associated with increases in high wage exogenous sectors show the importance of fluctuations in personal income to taxes. The composition of taxes changes slightly through the period, with personal income taxes averaging around 55 percent of total taxes throughout and corporate taxes growing from 11 percent to 16 percent of total by 2000. Petroleum royalty revenues from oil and gas reach a peak in 1986

TABLE 2.8. BASE CASE GROWTH OF THE FISCAL SECTOR
STATE OF ALASKA
1977-2000
(Millions of Dollars)

Year	Total Revenues	General Fund Balance	Permanent Fund Balance	Total Expenditures
1977[1]	1,133.54	695.948	42.99	980.65
1978	1,225.48	695.948	147.33	1,231.14
1979	1,391.29	674.967	343.23	1,335.50
1980	1,693.45	674.968	607.74	1,562.77
1981	1,926.87	674.969	911.75	1,766.84
1982	2,177.69	674.967	1,247.40	1,987.56
1983	2,450.06	674.967	1,630.95	2,218.53
1984	2,738.78	674.967	2,095.65	2,434.07
1985	3,029.67	674.968	2,633.97	2,661.16
1986	3,177.57	674.968	3,186.24	2,803.24
1987	3,180.16	603.385	3,716.67	2,905.72
1988	3,245.69	519.749	4,251.57	2,983.78
1989	3,290.81	378.468	4,783.29	3,096.86
1990	3,235.22	109.545	5,275.73	3,215.68
1991	3,241.97	0.000	5,486.85	3,353.03
1992	3,316.03	0.000	5,540.21	3,483.52
1993	3,394.13	0.000	5,530.45	3,634.20
1994	3,330.05	0.000	5,317.78	3,782.37
1995	3,328.75	0.000	4,946.10	3,950.65
1996	3,430.28	0.000	4,522.14	4,114.77
1997	3,455.98	0.000	3,945.86	4,304.71
1998	3,482.01	0.000	3,219.12	4,493.02
1999	3,518.72	0.000	2,324.17	4,711.63
2000	3,551.04	0.000	1,251.49	4,935.70

[1] Projected value may differ from actual 1977 estimate.

SOURCE: MAP Statewide Model

as production in the Prudhoe area begins to decline. Petroleum revenues make up a continually changing portion of total revenues, rising from 44 percent in 1977 to 63 percent at its peak and falling to 39 percent by the end of the period. Revenues from the interest on the general and permanent fund balances account for 11 percent of total revenues in 1990. By the end of the period, they account for only 4.6 percent of revenues. The decrease in this source of revenues results from the state drawing down these balances to maintain state spending at the constant real per capita levels. The state begins using the general fund in 1987 and the permanent fund in 1993 as a source of funds. As revenues from fund balance interest and petroleum decline, the increase in total revenues comes as a result of increases in taxes and other revenues. Other revenues include federal transfers and fees for state services, which increase as the population of the state grows. (Appendix C shows a breakdown of revenues and expenditures.)

Expenditures

Expenditures grow at an annual average growth rate of 13.3 percent prior to 1986 and 4.1 percent between 1986 and 2000. The slowdown in expenditures results from maintenance of constant real per capita expenditure after 1985; this per capita level is maintained because revenue increases are not fast enough to allow increases in real per capita expenditures. Expenditures increase only with inflation and population after 1985.

Real per capita expenditures can be considered a measure of the level of state services received by an individual. Real per capita state expenditures grow 69 percent until 1986, after which time they remain constant. The proportion of state spending on capital is reduced about one-third during the base period, from 30 percent of total expenditures to 20 percent, although yearly capital expenditures increase more than three times during the forecast period.

This growth in state expenditures repeats over a much longer period the experience of the state after the Prudhoe Bay lease sale. Rapid increases in revenues led to increases in expenditures; expenditures by the state increased by 59 percent between 1969 and 1970. This Prudhoe Bay experience may provide an indication of how the state will expand services in the future. Despite the rapid growth of expenditures during the historical period, the functional distribution of expenditure remained fairly stable. We may be able to infer that the state will continue to distribute increased expenditure between the nine functional categories (education, social services, health, natural resources, public protection, justice, development, transportation, and general government) as in the past (Goldsmith, 1977).

The increases in expenditure are of two types, providing additional services and providing the same level of services to an increased population. Increases in services occur only in the period prior to 1985. After 1985 expenditures increase only to provide the same level of services to a bigger population. During the period between 1977 and 1985, per capita real expenditures rise $662, which is a 68 percent increase in the level of services. This rise is less than that experienced after the Prudhoe lease sale, when between 1969 and 1973 real per capita expenditures rose 118 percent (Goldsmith, 1977).

Balances

The expenditure policy pursued by the state in the base case forces the state to draw down its fund balances before the end of the forecast period. The general fund balance has been completely depleted by 1990, and only $1.25 billion is left by 2000 in the permanent fund. This remaining amount is only 23 percent of the peak of $5,540.21 million, which was reached in 1992. This depletion of the funds results from the policy of maintaining real per capita expenditures in the face of declining revenues.

The decline in petroleum revenues after 1986 results in a reduction in the rate of increase in total revenues. The general fund must be drawn on after 1986 to maintain real per capita state expenditures. By 1991 expenditures are greater than revenues and the portion contributed to the permanent fund is reduced. By 1992 the permanent fund must be drawn down. This has implications for any future spending pattern the state develops which is tied to petroleum revenues. The cyclical nature of the petroleum revenues and their importance as a part of total state revenues means that expenditure policies which are tied to revenues will eventually lead to spending in excess of revenues. The massive jumps in services cannot be supported by normal revenues, and fund balances must be drawn on. Changes in the rate of spending out of increased revenues will only affect the timing of this occurrence, not its eventuality (Goldsmith, 1977).

EMPLOYMENT CHARACTERISTICS

Increased demand for industrial output results in the growth of Alaska employment. Depending on the source, growth will affect employment differently in different industries. The source of growth for exogenous sectors is external to the Alaska economy, while the growth of the endogenous sectors is influenced by the state economy. For the endogenous sectors, employment is determined from the demand for labor needed to produce a desired level of output. The demand for output is a function of real disposable personal income. Increases in the level of real disposable personal income lead to increases in the demand for goods and services, and this increased demand is translated into an increase in the demand for labor to be used as a factor of production. The state government sector influences employment in a different manner, which should be highlighted. First, state capital expenditures directly affect the output of the construction sector and the demand for labor in that sector. Second, the state spends directly on employment.

The Exogenous Sectors

Five sectors can be considered all or partly exogenous; they are mining, manufacturing, federal government, construction, and agriculture, fisheries, and forestries. Construction is a mixed sector, with both exogenous and endogenous components. By the end of the base period, mining has 93 fewer workers than at the beginning. Over the entire period, mining rises to a peak of 6,548 workers in 1981, then drops as a result of entering the production phase in various projects. Mining's share of total employment drops from 2.4 percent in 1977 to 1.5 percent by 2000. Manufacturing grows by approximately 4,600 workers in the period, which is an increase of about 40 percent. Manufacturing's share of total employment drops from 6.7 percent in 1977 to 5.7 percent by 2000. The level of federal government employment remains constant throughout the base period. The level of total federal government employment in Alaska has remained fairly constant in recent history because of decreases in military, which balanced increases in civilian employment. Because of this-, its share of employment falls by almost 8 percent, to 14.5 percent of total employment by 2000. Agriculture, forestry, and fisheries grows approximately 36 percent during the period; its share of total employment falls by approximately .1 percent, to .65 percent of total employment.

Exogenous construct" on employment is associated with major resource development projects. Major growth in this sector is limited to the early years of the period The last major year of TAPS construction is 1977; exogenous construction employment drops from 5,775 in 1977 to 900 in 1978. The construction of the Alcan gas line is the next major project. Alcan construction begins in 1979, and employment increases to a peak of 9,000 by 1980. After 1981 and completion of the major Alcan work, exogenous construction grows because of OCS development on the Northern Gulf and Lower Cook Inlet but never reaches more than 1,000 employees.

Total exogenous employment decreases in importance throughout the base period. By 2000 the exogenous sector is approximately the same size as in 1977, so its share of total employment has decreased. The exogenous sector impacts the growth of employment in two ways, it directly adds to employment and, by increasing the demand for local goods and services, increases employment in the local serving sector. The decrease in exogenous employment during the 1980s has a dampening effect on the Alaska economy. By 1990 the fall in exogenous construction and mining has stopped, and these sectors remain stable. Two factors reduce the impact of this on the economy. First, the dynamic nature of the state economy means that one-time major increases in employment will have long-term effects. Changes in personal incomes and population which occur during impact periods affect growth beyond this period. Second, wage rate increases throughout the period decrease the impact of the decline in employment and lead to increases in personal income with a stable employment level.

The State Government Sector

Growth of state and local government employment in the base case occurs as a response to increases in state revenues. A part of increases in state expenditures is reflected as increases in wages and salaries in state government. The other determinant of state employment is the wage rate. Once state wages and salaries expenditures are determined, the wage rate determines the maximum amount of employment.

State and local government employment increases to a peak of 40,783 in 1985, which is a growth of 10,367 employees for an annual average rate of growth of 3.7 percent. After 1985 real per capita state expenditures are maintained at a constant level. After 1985 state and local government employment falls until in 2000 there are 35,394 employees, which is approximately the same level as in 1981. This reduction in employment can be explained as a reaction of the state government when faced with rising real wages and a constraint on the increase in expenditures. The decrease is much less rapid than the increase to the peak, with employment falling at an average of .9 percent a year after the peak in 1985.

The Endogenous Sector

The majority of growth in the Alaskan economy in the base case occurs in the endogenous sector. Growth in this sector results because of increased demand for goods and services. Increases in real disposable personal income lead to increases in demand. As we have seen, real disposable personal income increases consistently throughout the period. A greater than proportional increase in endogenous employment is a typical observation in small developing economies. The Alaskan economy throughout the base period is still relatively small, and this growth in the endogenous sector is a continuation of the trend observed throughout the recent economic history of the state.

The fastest growing sectors of Alaska's economy are finance, services, and trade. Each of these sectors grows at an annual average rate greater than twice the rate of the whole economy. Trade employment increases to

20.4 percent of total employment by 2000. Finance increases to 4.9 percent and services to 19.3 percent in the same period. Comparison with the national average and other similar states shows that Alaska is particularly underserved in trade and services. The U.S. average is 20 percent of employment in trade and 24 percent in services (U.S. Department of Labor, 1977). The growth of these sectors results as Alaska provides a more normal share of its own goods and services. Other endogenous sectors also experience a healthy growth throughout the period. Transportation increases 67 percent during the base period. Endogenous construction grows at an annual average rate of approximately 3 percent. Table 2.9 details employment growth and structural change by sector for the base case. The differential industrial growth rates lead to changes in the structure of the Alaska economy. Limited growth in the exogenous sector has decreased its importance. Trade, services, and other local service sectors which are growing in response to rising personal incomes increase their importance.

Unemployment

Examining the rates of growth of total employment and population provides an indication of the possible impact on unemployment of base case growth. Throughout the base case period, population grows at an average annual rate of 1.6 percent, while employment grows at 1.9 percent. This slight difference in the rate of growth reduces the ratio of population to employment from 2.09 in 1977 to 1.96 by the year 2000.

TABLE 2.9. BASE CASE STRUCTURE OF THE ALASKA ECONOMY 1980, 1990, 2000

	1980		1990		2000	
	#	%	#	%	#	%
Mining	6,094	2.8	4,471	1.8	4,471	1.5
Construction	22,869	10.5	17,187	7.1	22,547	7.7
Manufacturing	13,831	6.3	16,370	6.7	16,662	5.7
Transportation	9,965	4.6	11,760	4.8	14,763	5.0
Trade	32,003	14.6	41,636	17.1	59,759	20.4
Finance	7,279	3.3	9,681	4.0	14,323	4.9
Service	28,476	13.0	37,575	15.4	56,538	19.3
Agriculture, Fisheries, Forestry	1,500	.7	1,700	.7	1,900	.6
Federal Government	42,500	19.4	42,500	17.5	42,500	14.5
State and Local Government	33,659	15.4	38,693	15.9	35,394	12.1
Other*	20,356	9.3	21,778	8.9	24,352	8.3

*Includes Public Utilities, Communication, and Other.

SOURCE: MAP Statewide Model

This reduction in the population to employment ratio could be assumed to infer a decrease in unemployment, since there will be fewer people per available job. However, the historical period will not support this conclusion. Table 2.10 shows that since 1970 the ratio of population to employment has decreased with little real effect on unemployment. However, this decrease was in a period of rapid growth connected with the construction of the Trans-Alaska Pipeline. This period was one of rapid growth in employment in which the labor force participation rate also rose. In periods of lesser growth, as in the base case, the labor force participation rates may go down. If this happens, a decrease in the ratio of population to employment could mean a decrease in unemployment.

Seasonality

Employment seasonality is a traditional problem of the Alaskan economy. Table 2.11 shows a measure of the seasonality of Alaska industry. Seasonality is examined by looking at the difference in peak and low month employment from the average. The farther the spread between high and low months, the more seasonal is the industry. Highly seasonal industries in 1975 are mining and construction; government, trade, and services are industries with low seasonal components. Seasonality defined in this way has decreased since 1950. Two probable causes of the reduction are changing technology, which allows production through all seasons, and a changing industrial structure, which makes less seasonal industries more important to the economy.

TABLE 2.10. HISTORICAL RATES OF POPULATION
TO EMPLOYMENT 1970-1975
STATE OF ALASKA

Year	Civilian Employment	Population	Population* / Employment	Unemployment Rate
1970	98,500	302,400	3.07	9.0
1971	103.800	311,000	2.99	10.4
1972	110,000	322,100	2.93	10.5
1973	115,600	330,400	2.86	10.7
1974	134,000	351,200	2.62	10.0
1975	164,100	404,600	2,47	8.1

*Differences from model results because employment in the model includes military.

SOURCE: MAP Statewide Model

TABLE 2.11. ALASKA EMPLOYMENT SEASONALITY BY INDUSTRY

		1950	% of Average	1965	% of Average	1970	% of Average	1975	% of Average
Total	high	55,400	1.320	81,500	1.156	103,400	1.119	182,000	1.128
	low	30,500	.730	60,000	.851	82,400	.892	130,100	.807
	average	41,800		70,500		92,400		161,300	
Mining	high	2,700	1.421	1,300	1.182	3,500	1.167	4,500	1.184
	low	1,100	.579	700	.636	2,500	.833	3,300	.868
	average	1,900		1,100		3,000		3,800	
Construction	high	9,700	1.540	9,400	1.469	9,300	1.348	35,900	1.386
	low	2,500	.397	3,500	,547	4,500	.652	12,800	.494
	average	6,300		6,400		6,900		25,900	
Manufacturing	high	13,000	2.281	11,000	1.746	13,600	1.744	14,300	1.490
	low	1,500	.263	3,700	.587	5,200	.667	6,300	.656
	average	5,700		6,300		7,800		9,600	
Transportation, Communication and Public Utilities	high	4,700	1.270	8,200	1.139	10,000	1.099	18,200	1.103
	low	2,900	.784	6,300	.875	8,400	.923	13,800	.836
	average	3,700		7,200		9,100		16,500	
Trade	high	5,700	1.163	10,900	1.090	16,300	1.065	28,400	1.084
	low	4,100	.837	8,900	.890	13,900	.908	22,500	.859
	average	4,900		10,000		15,300		26,200	
Finance, Insurance and Real Estate	high	500	1.250	2,300	1.045	3,500	1.129	6,700	1.117
	low	400	1.000	2,000	.909	2,700	.871	5,100	.850
	average	400		2,200		3,100		6,000	
Services	high	3,200	1.067	8,000	1.067	12,000	1.053	26,800	1.068
	low	2,700	.900	6,700	.893	10,800	.947	21,400	.853
	average	3,000		7,500		11,400		25,100	
Government	high	16,400	1.045	32,000	1.077	37,000	1.039	49,200	1.042
	low	15,000	.955	27,900	.939	33,700	.947	44,300	.939
	average	15,700		29,700		35,600		47,200	
Miscellaneous	high	300	1.500	200	2.000	400	2.000	2,000	2.000
	low	100	.500	0	0.000	100	.050	300	.300
	average	200		100		200		1,000	

SOURCE: Alaska Department of Labor, "Alaska Labor Force Estimate by Area" annual and "Workforce Estimates for Alaska" annual, The base case described above projects tremendous growth in services, trade, finance, and transportation. These industries were, except for government, the least seasonal in 1975. Because of this change in industrial structure, it can be assumed that the seasonality of Alaska industry will decline throughout the period regardless of changes in technology.

POPULATION CHARACTERISTICS

Population increases at an average annual rate of 1.6 percent during the base case period. There are two distinct periods of population growth. Population peaks with employment at 466,927 when ALCAN construction peaks in 1981. Prior to 1981, there is an annual growth rate of 3.9 percent per year. After this peak, population drops by almost 4,000 people and grows at an annual rate of 1.2 percent until 2000. Population growth closely parallels the growth in employment. The state experience since 1970 has been a much faster population growth; average annual growth between 1970 and 1976 was 5.4 percent.

Population growth is a result of natural increase and migration. In the recent past migration has been an important cause of growth. Population growth is affected by outmigration in the forecast period; for over half the period, there is outmigration. Migration is determined by the relative economic opportunities available in Alaska. Changes in employment opportunities or the relative per capita income in Alaska will affect migration. Small increases in employment result in net outmigration, since jobs are taken up by the natural increase in the Alaska labor force. Migration in the early years of the forecast period is affected by changes in exogenous construction associated with the TAPS and Alcan pipelines. Migration is as high as 5 percent of total population during this period. After the completion of the Alcan, there is a short period of net immigration; growth in the state government sector and in the local serving sector is primarily responsible. After 1985 when the rate of growth in state expenditures is decreased and large decreases in mining occur, the state experiences net outmigration until 1998. During this period, outmigration is never a very large component of population change; at its largest, migration is 1.5 percent of total population.

Migration has considerable effect on the age-sex distribution. Table 2.12 shows the changes in this distribution in three periods. The most noticeable trend is toward a general aging of the population. By 2000 the proportion of the population in the age groups over forty have increased. This increase is a result of the migration process. Migration, which is economically determined, affects primarily the age groups less than forty. Migration after forty is a response to other factors, such as retirement and the high cost of living (Seiver, 1975). Because of this, the outmigration during the forecast period affects the younger age groups. Table 2.12 shows the importance of this effect on the age structure. By 2000, the proportion of the population in the 40 and older age group is 20 percent greater than in 1990, which may be considered a more normal year than 1980. This trend actually brings the Alaska age distribution closer to the national norm.

TABLE 2.12. AGE-SEX STRUCTURE OF THE POPULATION
BASE CASE
(% of total population)

	1980		1990		2000	
	Male	Female	Male	Female	Male	Female
0-1	1.19	1.19	1.05	1.06	1.02	1.02
1 - 4	4.49	4.09	4.23	4.00	3.78	3.59
5 - 9	4.75	4.20	5.14	4.95	4.64	4.47
10 - 14	4.33	4.22	4.54	4.38	4.42	4.25
15 - 19	4.93	4.10	4.04	3.82	4.27	3.97
20 - 24	8.55	5.68	5.40	3.72	5.52	4.02
25 - 29	6.01	5.24	4.36	3.73	3.68	3.45
30 - 34	4.67	4.49	4.57	4.08	3.40	3.26
35 - 39	3.61	3.22	4.45	3.79	3.56	3.12
40 - 44	2.54	2.41	3.62	3.35	3.42	3.15
45 - 49	2.04	1.84	2.81	2.64	3.19	2.94
50 - 54	1.78	1.57	2.18	2.09	2.80	2.65
55 - 59	1.49	1.31	1.69	1.64	2.25	2.22
60 - 64	1.19	1.06	1.35	1.34	1.75	1.83
65 +	1.97	1.84	2.84	3.14	3.70	4.66

SOURCE : MAP Statewide Model

Native population increases at an annual average rate of about 2 percent. This rate reflects natural rates of increase from the historical period. This is slightly larger than historical rates of growth found by Rogers between 1960 and 1970; according to the Census between 1960 and 1970, the average annual growth rate was 1.8 percent (Rogers, 1971). Because Native population is growing faster than total population, it increases from 17 percent of total population in 1977 to 19 percent in 2000. Table 2.13 details the population characteristics of growth.

Growth of the Regional Economies

State economic growth does not occur uniformly throughout the state but varies by region. Regional growth depends on the factors causing growth. Factors which have a similar influence on state growth may affect the growth in each reg· on differently. For example, equal growth in state government employment and exogenous employment, although they may affect state growth the same, will differ in their regional impacts, depending on the concentration of exogenous employment and the dispersion of state government expenditures.

The causes of regional growth are the same as those at the state level--increases in exogenous employment, increases in personal income, and increases in state expenditures. Growth of any of these factors within the region will lead to growth in the region. Regions will also be influenced by other factors; most importantly, the increase in state revenues and expenditures will lead to growth in regions which do not include exogenous growth. Changes in wage rates which result from employment growth will

TABLE 2.13 BASE CASE GROWTH OF THE ALASKAN POPULATION
1977 - 2000

Year	Total Population	Net Migration	Native Population
1977[1]	399,968	-25,997	67,917
1978	402,357	-5,456	69,275
1979	419,124	9,277	70,661
1980	449,203	22,177	72,074
1981	466,927	8,780	73,515
1982	463,198	-12,983	74,985
1983	470,099	-1,553	76,485
1984	479,525	1,148	78,015
1985	491,935	4,159	79,575
1986	500,022	-293	81,166
1987	503,990	-4,329	82,790
1988	504,373	-7,641	84,446
1989	508,403	-3,581	86,134
1990	512,526	-3,316	87,857
1991	518,104	-1,727	89,614
1992	522,414	-2,962	91,406
1993	528,300	-1,307	93,234
1994	533,322	-2,193	95,099
1995	539,760	-763	97,001
1996	545,167	-1,863	98,941
1997	552,447	-4	100,920
1998	588,855	-989	102,939
1999	567,344	1,032	104,997
2000	575,574	613	107,097

[1]Projected value may differ from actual 1977 estimate.

SOURCE : Map Statewide Model

lead to increased personal income in a region not directly affected by exogenous growth. Growth in regional centers, such as Anchorage and Fairbanks, is also influenced by growth in other regions of the state.

The economies of Alaskan regions are not independent, but are interdependent. Because of this, growth in one region will affect growth in other regions. Four processes reflect this interaction; the strength of the interdependence of the Alaskan regional economies depends on the strength of these processes. First, government spending works to distribute growth between the regions. Increases in state revenues which result from growth in one region will be translated into growth in other regions through the distribution of state expenditures. State expenditures are distributed to a region in relation to its population. However, government centers such as Anchorage and Juneau receive a greater than proportionate share of state expenditures because of the administrative and headquarters functions they serve. Second, changes in state wage rates will affect growth in the regions. Increases in wage rates increase personal incomes in each region and the demand for goods and services in each region. Wage rate increases throughout the state can result from rapid increases in construction employment in one region. Third, regions which serve as regional centers will reflect growth in other regions, since they provide goods and services to other regions. The growth of Anchorage, which serves as the financial, distributional, and administrative center of the state, is the most obvious example of this, although smaller centers such as Fairbanks also experience this type of relation. Finally, migration between regions illustrates interaction of the regional economies. Residents of one region respond to employment opportunities in another region by migrating to it, so that employment growth in one region determines the population of other regions.

This section will describe the distribution of state growth in the base case between three regions of the state--the North Slope Borough, Anchorage, and Fa· rban ks. Anchorage is the largest urban center in the state which serves as the financial, administrative, and distribution center for most of the state. Because of this role, growth in most of the state is reflected in growth in Anchorage. Fairbanks is a smaller regional center which recently experienced tremendous growth because of its role as operations center for the pipeline. The North Slope region is basically rural but is unique because of the tremendous petroleum activity which occurs within its boundaries. Petroleum activity at Pruchoe Bay, National Petroleum Reserve, and possible activity in the Arctic Wildlife Refuge and the Beaufort Sea all occur within the borough boundaries.

ANCHORAGE

Employment

Employment in Anchorage more than doubles during the base period, increasing from 82,752 in 1977 to 168,310 by 2000. Rapid growth is experienced during the construction of the ALCAN gas line; from 1978 until 1981 when the peak employment on the ALCAN is reached, the average annual growth of total employment is 5.7 percent, which is a" most twice the average annual growth rate for the whole forecast per· od . Direct Alcan employment is only 626 at its Anchorage peak in 1980; this is only .7 percent of the total Anchorage employment.

Growth in Anchorage is a result of increasing personal income and increasing demand for local products. ‘Throughout the base period, growth of employment in Anchorage averages 3.1 percent per year. This is more than a percent higher than the growth of state employment. Because Anchorage is growing faster than the rest of the state, employment is being concentrated in the state’s main metropolitan center. The scale of the Anchorage economy and its role as the financial, distributional, and administrative center for the rest of the state account for both the continued concentration of the state’s employment in Anchorage and the healthy growth Anchorage maintains in a period of only moderate growth for the remainder of the state. Because of its size, more of the demands for goods and services can be met in Anchorage. This means that greater growth results from equal increases in personal income than in the smaller regions of the state. Anchorage’s role as the financial, distributional, and administrative center of the state means that this region will provide goods and services to other regions of the state. Increases in personal income in other regions will, therefore, lead to increased demand for goods and services in Anchorage and growth in Anchorage. Because of this function, growth in the rest of the state leads to growth in Anchorage. These two effects account for the faster growth in Anchorage. Tables 2.14 and 2.15 summarize the changes in Anchorage employment.

TABLE 2.14. BASE CASE GROWTH OF
ANCHORAGE ECONOMY
1977 - 2000

Year	Population	Total Employment	Personal Income (millions of $)
1977[1]	169,704	82,752	1,568.56
1978	178,166	83,200	1,626.21
1979	183,832	86,742	1,790.62
1980	194,636	94,178	2,093.61
1981	205,468	98,363	2,308.42
1982	212,561	97,299	2,350.92
1983	218,881	99,726	2,520.34
1984	226,590	102,963	2,730.33
1985	234,393	106,942	2,986.72
1986	240,447	109,817	3,212.04
1987	244,764	111,484	3,395.37
1988	246,582	112,553	3,560.22
1989	250,617	114,733	3,787.27
1990	254,910	117,490	4,050.72
1991	260,327	120,833	4,360.86
1992	265,097	124,059	4,676.54
1993	271,092	128,139	5,055.18
1994	276,490	132,138	5,445.28
1995	283,070	136,744	5,891.92
1996	289,277	141,555	6,369.37
1997	296,892	147,193	6,923.64
1998	304,282	153,216	7,525.87
1999	313,361	160,346	8,233.04
2000	322,608	168,310	9,026.04

[1]Projected value may differ from actual 1977 estimate.

SOURCE: MAP Regional Model

TABLE 2.15. STRUCTURE OF THE ANCHORAGE ECONOMY
- BASE CASE -
1980, 1990, 2000

	1980		1990		2000	
	#	%	#	%	#	%
Mining	1,009	1.1	1,009	.9	1,009	.6
Construction	5,971	6.3	7,101	6.0	10,392	6.2
Manufacturing	1,895	2,0	2,100	1.8	2,100	1.2
Transportation	5,182	5.5	5,896	5.0	8,772	5.2
Trade	18,733	19.9	25,511	21.7	41,490	24.7
Finance	4,405	4.7	7,013	6.0	13,084	7.8
Service	14,416	15.3	23,598	20.1	45,847	27.2
State & Local Govt.	11,981	12.7	13,882	11.8	12,738	7.6
Federal Govt.	22,100	23.5	22,100	18.8	22,100	13.1
Other*	8,486	9.0	9,280	7.9	10,778	6.4

*Includes Agriculture, Communications, Public Utilities, and Other.

SOURCE: MAP Regional Model

The fastest growing sectors in the Anchorage economy are services and finance. The service sector grows at an annual average rate of 6.2 percent throughout the period, while finance grows at a rate of 5.8 percent. As in the state, the endogenous sector in Anchorage experiences the most rapid growth; this is accentuated in Anchorage, because it provides many of the services associated with the finance, trade, service, and transportation sectors for the rest of the state. Employment in the transportation sector more than doubles during the base period in Anchorage, as does trade sector employment.

State and local government employment follows the same pattern in Anchorage as in the rest of the state. Employment rises rapidly until 1985, averaging 4.0 percent per year, after which it begins to fall. The fall in employment is a result of the slowdown in the growth of state expenditures which results from the tightening of revenues in the later years of the period. The reduction in state and local government employment is at a much slower rate than its growth, averaging less than 1 percent a year. The reduction in employment does not necessarily reduce the impact of state expenditures on the local economy, since wage rates increase throughout the period.

The structure of the Anchorage economy has prevented seasonality from becoming as important a problem in Anchorage as in the remainder of the state. Peak employment was only 7 percent greater than the annual average in 1970 and 9 percent greater in 1975. The importance of trade, services, and finance in the Anchorage economy is responsible for this.

Since the base case projects an increase in the importance of these industries, seasonality can be expected to remain a small problem in the Anchorage economy.

Population

During the base period, population growth is, like employment growth, centered in Anchorage. Anchorage increases its share of total state population from 42 percent in 1977 to 56 percent in 2000. Anchorage population grows smoothly throughout the period. Prior to 1990, the growth rate in Anchorage is an annual average of 3.3 percent a year. This falls to 2.4 percent after 1990, but population continues to rise throughout the period. Because Anchorage growth results primarily from the expansion in the support sector, it is not subject to major fluctuations in population as are the other regions. Anchorage population growth is shown in Table 2.14.

Personal Income

Changes in personal income in a region are as important to its economic growth as changes in state spending and exogenous employment. Increases in personal income lead to increases in demand and to increased employment, Anchorage experiences the fastest growth in personal income of any region. Personal income grows at an annual average rate of 8.1 percent throughout the period. Table 2.14 shows the growth in personal income.

THE NORTH SLOPE

Employment

Total employment in the North Slope region experiences considerable fluctuation during the base period. Total employment falls in 1978 with the completion of the TAPS line. From 1978 to 1981 employment increases by 3,841 as a result of increases in construction employment related to the Alcan line and increases in mining employment on state leases near Prudhoe Bay. Reductions in employment at Prudhoe Bay and on the Alcan result in a drop of employment, from 8,879 in 1981 to 5,644 by 1983. Employment at other Prudhoe fields increases until 1986, when they account for the majority of the mining employment in the North Slope. After 1990 the economy continues to grow with a stable exogenous sector. Employment increases at an average rate of 2.7 per year after 1990. The North Slope economy is effectively two sectors, a local economy and an enclave petroleum economy. Although some enclave sector jobs are in transportation and non-pipeline construction, the percentage of total employment in mining and pipeline construction gives some indication of the distribution between local sector and enclave sector jobs. Over one-third of the jobs in the borough are connected with the enclave sector in the early part of the period. Once employment levels in this sector stabilize, its share of total borough employment is reduced. By 2000 enclave employment accounts for only 19 percent of the borough total.

A second major influence on the growth of employment in the North Slope is expenditures by the borough. Borough expenditures take two forms--capital expenditures and current expenditures. Capital expenditures are assumed to remain at the levels shown in Table 2.16. The levels assumed are intermediate between those suggested in the borough's 1977 CIP (North Slope Borough, 1977) and the CIP which could be undertaken if 25 percent of the borough's revenues were spent on the CIP. The Capital Improvement Program maintains employment at 127 until the 1977 program is completed in 1990. After this, CIP-related employment drops to that which could be financed by 25 percent of the borough's revenues. Current expenditures by the borough provide a direct link between the production at Prudhoe Bay and the local economy. According to state law (Alaska Statutes, Section 29.53.045), the borough is allowed to tax oil-related property at a rate of $1500 for each person in the borough.* Increased employment at Prudhoe Bay increases the borough's population, and this increases its revenues. Increased revenues lead to greater expenditure on local government employment.

As on the state level, wage rates in the state and local government sector are influenced by wage rate changes outside the region. Increases in the wage rate lead to decreased employment in the state and local government sector even with increased expenditure on employment. State and local government employment increases to a peak of 855 in 1983 and decreases during the remainder of the period. Decreases are a result of increases in revenues and expenditures at both the state and local government not keeping up with wage rate increases.

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*During the course of this study, the borough and the state agreed on an alternative formula allowed under this statute. See Alaska Statutes, Section 29.53,045(c).

TABLE 2.16. ASSUMED CAPITAL IMPROVEMENT PROGRAM OF THE NORTH SLOPE BOROUGH

Year	CIP Expenditure	Average Annual CIP Employment
1977	$4,730,000	
1978	8,540,000	1;;
1979	8,540,000	127
1980	8,540,000	127
1981	8,540,000	127
982	8,540,000	27
983	8,540,000	27
984	8,540,000	27
985	8,540,000	27
986	8,540,000	27
987	8,540,000	27
988	8,540,000	27
1989	5,921,000	88
1990	3,124,000	47
1991	3,189,000	48
1992	3,257,000	49
1993	3,326,000	50
1994	3,398,000	51
1995	3,472,000	52
1996	3,548,000	53
1997	3,626,000	54
1998	3,707,000	55
1999	3,789,000	56
2000	3,875,000	58

SOURCE: Estimated from North Slope Borough, Capital Improvement Program, 1977.

Total employment by 2000 is 50 percent higher than it was in 1978 after completion of the Trans-Alaska Pipeline. North Slope total employment experiences two peaks during the base period, one in 1981 resulting from construction of the gas line and a second smaller peak in 1986 which results from increased petroleum activity on other state leases near Prudhoe Bay. At each of these peaks, mining and pipeline construction employment are approximately 40 percent of the borough total. Total employment falls until 1990, when exogenous employment stabilizes at 1,414. After 1990 total employment grows at an annual average rate of 2.7 percent per year as a result of income increases in the local economy.

The fastest growing industrial sector in the North Slope is transportation which more than doubles during the period. Transportation serves both the exogenous sector and the local economy. Since most goods are imported into the region, increased demand for goods resulting from increasing incomes leads to increased demand for transportation services. Finance and services increase by about 60 percent in the base period. The trade sector grows slightly faster than total employment; it grows about 52 percent over the base period. The expansion of these sectors is a response to increases in incomes in the region. The expansion of the local support sector is an expected trend in the growth of a small region. Tables 2.17 and 2.18 detail the employment growth and structural change in the regional economy.

Between 1970 and 1975, the seasonality in the North Slope was importantly reduced. Peak employment in 1970 was 44 percent greater than the annual average, while in 1975 it was only 17 percent greater. Measured by these

TABLE 2.17. BASE CASE GROWTH OF NORTH SLOPE ECONOMY 1977 - 2000

Year	Population	Total Employment	Personal Income (millions of $)
1977'	9,322	6,489	285.891
1978	7,168	5,036	195.759
1979	8,515	6,605	292.150
1980	9,979	8,307	422.479
1981	10,678	8,878	476.940
1982	8,384	6,754	334.252
1983	8,190	6,743	345.954
1984	8,251	6,906	375.278
1985	8,273	7,042	406.686
1986	8,477	7,256	442.805
1987	8,258	7,013	440.614
1988	7,286	6,066	383.678
1989	7,079	5,785	377.085
1990	7,110	5,768	392.798
1991	7,300	5,902	426.389
992	7,448	6,015	458.188
993	7,641	6,181	499.886
994	7,796	6,321	539.225
995	7,983	6,483	583.955
996	8,157	6,650	631.854
997	8,365	6,843	686.665
998	8,561	7,045	745.823
999	8,795	7,278	813.812
2000	9,020	7,532	888.973

'Projected value may differ from actual 1977 estimate.

SOURCE : MAP Regional Model

TABLE 2.18 STRUCTURE OF THE NORTH SLOPE ECONOMY
- BASE CASE -
1980, 1990, 2000

	1980		1990		2000	
	#	%	#	%	#	%
Mining	1,759	21.2	1,414	24.5	1,414	18.8
Construction	3,857	46.4	1,492	25.9	2,783	36.9
Transportation	341	4.1	384	6.7	610	8.1
Trade	164	2.0	180	3.1	230	3.1
Finance	79	0.9	83	1.4	112	1.5
Service	536	6.5	584	9.5	757	10.0
State & Local Govt.	714	8*6	789	13.7	711	9.4
Federal Govt.	425	5.1	425	7.4	425	5.6
Other*	433	5.2	418	7.2	491	6.5

*Includes Communications, Public Utilities, and Other.

SOURCE: MAP Regional Model

peaks, seasonality was greater than in the state as a whole. One important reason for this is the growth of government employment which is less seasonal than employment in other sectors. In the base case, the local support sector is projected to grow in importance. Because this sector is less seasonal, seasonality should be reduced even more.

Population

In the North Slope, population decreases and increases dramatically with changes in the exogenous employment associated with natural resource development. Population in the North Slope increases to a peak of 10,678 with construction of the Alcan and falls, then rises to 8,477 in 1986 with increases in mining employment. By 1990 exogenous employment has reached a plateau which it maintains throughout the remainder of the period. After this period, population increases at an annual rate of 2.2 percent a year. Employment in the enclave sector (mining and pipeline construction) merely works in the borough but does not require services. The enclave population is 23 percent of the total in 1977; by 1981 when population peaks at 10,678, the enclave sector accounts for 34 percent of total population. At the end of the period in 2000, after ten years of stable enclave sector employment, enclave population accounts for 16 percent of total population. The share of the state population in the North Slope falls from 2.3 percent in 1977 to 1.6 percent by 2000 (see Table 2.17).

Personal Income

Personal income in the North Slope grows at an average rate of 7.1 percent per year. This growth is significantly influenced by the growth of the enclave sector. Prior to 1990, personal income on the North Slope rises and falls with changes in the level of exogenous employment. After 1990 when North Slope exogenous employment stabilizes, personal income grows at an average rate of 8.5 percent per year (see Table 2.17).

FAIRBANKS

Employment

Total employment increases only slightly throughout the base period; total employment increases by only 3,520 between 1977 and 2000. The most important factors affecting the growth of Fairbanks are changes in the exogenous sector of the economy. Employment falls in the first year of the base period from 33,867 in 1977 to 28,347 in 1978. This fall is a result of the completion of the Trans-Alaska Pipeline construction. Employment rises about 10,000 In the next two years because construction of the Alcan gas line begins in 1979. With the completion of this construction, total employment falls by about 8,400, which is more than twice the drop in direct construction employment of 3,191. After 1983 the Fairbanks economy begins to grow; throughout the remainder of the period employment grows at an average rate of 1.05 percent per year. Growth in state and local government expenditures and personal income are responsible for this growth.

Like Anchorage and the North Slope, Fairbanks experiences an increase during the period of the local support sector. After the completion of the Alcan line, employment in transportation, services, finance, and trade all increase at more than twice the rate of growth of total employment. As in the North Slope, the fastest growing sector is transportation. Employment in transportation increases at an annual average rate of 3 percent after the end of the gas 1 ne construction. As incomes increase in small regions, the demand for goods and services cannot be fully met within the region, which results in an ncreased demand for transportation to import goods and services. This explains the different structural changes in the small regions, Fairbanks and the North Slope, and the larger region, Anchorage In larger regions, more of the increased demand for goods and services can be met within the region. Tables 2.19 and 2.20 detail changes in employment in the Fairbanks region.

The importance of trans-Alaska pipeline construction in Fairbanks in 1975 led to an increase in the seasonality of employment from 1970. In 1970 employment in Fairbanks in the peak month was 6 percent greater than the annual average. In 1975 peak employment was 15 percent greater. Because the TAPS project is not typical, it can be assumed that seasonality is less of a problem in Fairbanks than in the remainder of the state. The local support sector, which is not as seasonal as construction, will increase in the base case. This will reduce the importance of seasonality.

TABLE 2.19. BASE CASE GROWTH OF FAIRBANKS ECONOMY -1977 - 2000

Year	Population	Total Employment	Personal Income (millions of $)
1977[1]	70,015	33,867	811.354
1978	61,549	28,346	607.406
1979	68,212	32,081	766.243
1980	81,159	39,790	1,099.960
1981	81,018	39,238	1,128.070
1982	67,337	30,804	812.263
1983	67,734	30,797	843.960
1984	69,126	31,359	905.077
1985	70,234	32,000	975.649
1986	70,944	32,385	1,036.940
1987	71,416	32,564	1,085.760
1988	70,753	32,433	1,119.580
1989	70,670	32,574	1,174.080
1990	70,636	32,835	1,239.070
1991	70,717	33,153	1,313.340
1992	70,638	33,431	1,386.890
1993	70,651	33,804	1,472.240
1994	70,509	34,137	1,557.430
1995	70,500	34,525	1,651.970
1996	70,315	34,898	1,749.180
1997	70,243	35,333	1,857.590
1998	69,992	35,761	1,970.030
1999	69,831	36,256	2,095.590
2000	69,474	36,763	2,228.010

[1]Projected value may not agree with actual 1977 estimates.

SOURCE: MAP Regional Model

TABLE 2020. STRUCTURE OF THE FAIRBANKS ECONOMY
- BASE CASE -
1980, 1990, 2000

	1980		1990		2000	
	#	%	#	%	#	%
Mining	309	.8	309	.9	309	.8
Construction	5,828	14.6	1,678	5.1	1,816	4.9
Manufacturing	635	1.6	712	2.2	712	1.9
Transportation	2,216	5.6	1,816	5.5	2,553	6.9
Trade	6,985	17.6	5,505	16.8	7,117	19.4
Finance	1,384	3.5	1,169	3.6	1,560	4.2
Service	5,486	13.8	4,014	12.2	5,309	14.4
State & Local Govt.	5,143	12.9	5,700	17.4	5,139	14.0
Federal Govt.	8,713	21.9	8,713	26.5	8,713	23.7
Other*	3,091	7.8	3,219	9.8	3,535	9.6

*Includes Agriculture, Communications, Public Utilities, and Other.

SOURCE: MAP Regional Model

Population

As indicated in Table 2.19, the population of Fairbanks is also importantly influenced by exogenous employment. Fairbanks' population increases to a peak of 81,159 with Alcan construction, then drops to 67,338, which is an increase of 9.4 percent over the low point following the construction of the TAPS line. After 1982 population increases at a rate of 1.2 percent a year until 1987, at which time it begins to fall. Over the remaining thirteen years in the base period, population falls by approximately 2,000 people. This fall in population is a result of faster growth in other regions, which attracts Fairbanks residents.

Personal Income

During the base period, personal income in Fairbanks grows at a rate of 6.1 percent per year. Personal income falls with the end of the Alcan construction in 1981. After 1981 personal income grows at an average rate of 5.8 percent per year (see Table 2.19).

III. THE IMPACTS OF OFFSHORE DEVELOPMENT IN THE BEAUFORT SEA

In order to capture the important dimensions of the uncertainty surrounding oil and gas development in the Beaufort Sea, the development patterns implied by four alternative resource discovery scenarios were examined and contrasted with the base case projections presented above. The scenarios were designed to capture differences in resource quantities, transport requirements, technology, and resource ownership, all of which will affect the impacts of any developments which actually occur. This section examines the assumptions which form the basis of the scenarios to be examined and the next section presents the economic impacts implied by each of these scenarios.

The Development Scenarios

Four offshore development scenarios were examined, based on geological, technical, and employment data prepared by Dames and Moore (Dames and Moore, 1978). Three of these scenarios describe development associated with the joint federal/state lease sale tentatively scheduled for 1979. A fourth development scenario describes activities associated with a currently unscheduled federal lease sale in the area of Cape Halkett, west of Prudhoe Bay. In this part, we outline the major assumptions contained in each of these scenarios.

ASSUMPTIONS COMMON TO ALL SCENARIOS

Five assumptions are incorporated into all four development scenarios:

First, it is assumed that any discoveries falling on properties whose ownership is currently in dispute will eventually fall under federal, rather than state, jurisdiction.

Second, it is assumed that all tracts leased in the joint federal/state sale will be leased according to a conventional scheme of bonus bidding with fixed royalty rates. The total bonus bid in the joint federal/state sale is assumed to be $500 million, half of which goes to the state. The royalty rate is assumed fixed at the federal rate of 1/6 of wellhead value for all tracts, both federal and state.

Third, it is assumed that any discoveries of oil and gas on state-owned properties will be subject to state production taxes at current rates.

Fourth, it is assumed that the state government spends incremental revenues from offshore development according to the same expenditure rule assumed in the base case.

Finally, it is assumed that all oil and gas production from the Beaufort Sea area is transported via the TAPS and ALCAN pipelines rather than by new pipelines or alternate modes such as ice breaking tankers.

Obviously, these assumptions are highly speculative. The state may win its jurisdictional dispute with the federal government, alternative leasing schemes such as royalty bidding are a distinct possibility, and the production tax rate may well vary over time. The state's adjustment to changes in its fiscal position may differ from the process assumed here, and alternative transport modes have been suggested as feasible. As in the selection of a base case, the measured impacts are not insensitive to these variations from our assumptions, and the effects of such variations are taken up in the sensitivity analysis in Chapter IV.

SCENARIO SPECIFIC ASSUMPTIONS

Each development scenario consists of four sets of related assumptions which describe a consistent development plan for each of the selected areas. The first set of assumptions describes the estimated levels of recoverable resources at each site. The second set of assumptions consists of the direct employment requirements implied by a set of activities designed to explore, develop, and eventually bring the field into production. The third set of assumptions relates to the timetable of resource production implied by the development plan at each site. Finally, a fourth set of assumptions describes the direct effects of the development on state petroleum revenues.

Four scenarios were examined. The first three represent activities surrounding the development of fields in the area of the joint federal/state lease sale. Of these, two scenarios describe development. of an offshore field north of the existing onshore discoveries at Prudhoe Bay. The first of these represents a high level of resource discovery and the second a much smaller discovery. A third scenario describes the development of a field offshore in the Camden Bay area to the east of Prudhoe, also within the area of the joint sale. A fourth scenario describes activities associated with the sale of tracts in a federal lease sale in the Cape Halkett area west of Prudhoe, assumed to be held in 1984.

We now turn to the specific assumptions characterizing each of these scenarios.

Offshore Prudhoe Bay (High Discovery Case)

The first Prudhoe scenario examined represents activity surrounding discoveries on tracts leased in the joint federal/state sale, assumed held in 1979. As shown in Table 3.1, it is assumed that 1.9 billion barrels of oil and 4.75 trill on cubic feet of gas are discovered.

Exploration activity in this scenar o begins in 1979, with facility construction commencing one year later Construction employment peaks at over 1600 workers by 1986 but drops sharply in 1988 to a nominal crew of 5 workers as production commences. As construction declines, petroleum employment in development and production activities peak at over 1200 in 1988, gradually declining to a permanent production work force of 935. Over 800 of this permanent work force is located in the North Slope Borough, with a small contingent of administrative personnel gradually expanding in Anchorage as the development proceeds. The full schedule of direct employment requirements implied by this scenario, by industry and region, is presented in Table 3.2.

TABLE 3.1. ASSUMED RECOVERABLE RESERVE LEVELS

Scenario	Oil (Billion Barrels)	Gas (Trillion Cubic Ft.)
Prudhoe (High)	1.9	4.75
Prudhoe (Low)	0.8	1.6
Camden-Canning	1.3	3.25
Cape Halkett	0.8	0

SOURCE: Dames and Moore, 1978

TABLE 3.2. DIRECT EMPLOYMENT REQUIREMENTS
-PRUDHOE (HIGH) SCENARIO-

Year	Petroleum Sector			Construction Sector	Total		
	Region 1	Region 5	State	(Region 1 only)	Region 1	Region 5	State
1979[1]	60	6	66	0	60	6	66
1980	108	11	119	60	168	11	179
1981	92	11	103	18	110	11	121
1982	33	11	44	86	119	11	130
1983	33	11	44	86	119	11	130
1984[2]	33	11	44	99	132	11	143
1985	16	11	27	240	256	11	267
1986	165	26	191	1668	1833	26	1859
1987	264		300	1422	1686	36	1722
1988[3]	1096	1;:	1215	5	1101	119	1220
1989	1096	119	1215	5	1101	119	1220
1990	1096	119	1215	5	1101	119	1220
1991	1096	119	1215	5	1101	119	1220
1992	976	119	1095	5	981	119	1100
1993	936	119	1055	5	941	119	1060
1994	831	119	950	5	836	119	955
1995	816	119	935	5	821	119	940
1996	816	119	935	5	821	119	940
1997	816	119	935	5	821	119	940
1998	816	119	935	5	821	119	940
1999	816	119	935	5	821	119	940
2000	816	119	935	5	821	119	940

[1] Exploration begins
[2] Development begins
[3] Production begins

Region 1 - North Slope
Region 5 - Anchorage

SOURCE: Dames and Moore, 1978

Oil and gas production at the site begin in 1988, peaking at a level of .6472 million barrels of oil and 520 million cubic feet of gas per day by 1992. The complete production schedule is presented in Table 3.3.

The new development has several effects on state petroleum revenues. First, the state will receive some share of any initial bonus payments derived from the joint sale. As mentioned above, this amount is assumed to be $250 million received in two equal shares in 1980 and 1981. Second, the state will receive increased royalty payments and production taxes from any production occurring on state-owned offshore tracts. Third, inasmuch as all new production is assumed to flow through the TAPS and Alcan lines, the tariff decrease produced by this increased flow will increase the wellhead value of, and consequently the royalty and production taxes from, existing base case production from state lands. Finally, the facilities required for the development are subject to state property taxes on oil and gas properties, so that new facility construction will generate increased property tax revenue.

In this scenario, the Prudhoe development at its peak increases total annual state petroleum revenues by $958 million in 1993. Of this, approximately 7 percent is due to increased property taxes, 36 percent is due to increased production taxes, and 57 percent is due to increased royalty payments. Table 3.4 presents a complete breakdown of these revenue effects. It should be mentioned that these are only the direct effects on exogenous revenues. Other revenue items, such as personal and corporate income taxes, fees, and federal grants tied to state

TABLE 3.3. PRODUCTION SCHEDULE
-PRUDHOE (HIGH) SCENARIO-

Year	Oil (MMBD)	Gas (MMCPD)
1988	.0839	520
1989	.3000	520
1990	.4648	520
1991	.6024	520
1992	.6472	520
1993	.6350	520
1994	.5650	520
1995	.4605	520
1996	.3599	520
1997	.2730	520
1998	.2095	520
1999	.1614	520
2000	.1227	520

SOURCE: Dames and Moore, 1978

TABLE 3.4. DIRECT EFFECTS ON STATE PETROLEUM REVENUES***
-PRUDHOE (HIGH) SCENARIO-
(Millions of $)

Year	Bonus Payments	Royalty Payments: From New* Production	Royalty Payments: From Old** Production	Royalty Payments: Total	Production Taxes: From New* Production	Production Taxes: From Old** Production	Production Taxes: Total	Property Tax	Total
1979[1]		0	0	0	0	0	0	0	0.0
1980	1:5	0	0	0	0	0	0	.7	125.7
1981	125	0	0	0	0	0	0	1.0	126.0
1982	0	0	0	0	0	0	0	2.2	2.2
1983	0	0	0	0	0	0	0	3.6	3.6
1984[2]	0	0	0	0	0	0	0	5.3	5.3
1985	0	0	0	0	0	0	0	9.4	9.4
1986	0	0	0	0	0	0	0	37.9	37.9
1987	0	0	0	0	0	0	0	64.8	64.8
1988[3]	0	55.3	89.5	144.8	34.0	72.9	106.9	64.8	316.5
1989	0	183.7	82.1	265.8	112.3	66.4	178.7	64.8	509.3
1990	0	295.0	74.2	369.2	178.7	59.6	238.3	64.8	672.3
1991	0	403.6	72.3	475.9	244.5	58.1	302.6	64.8	843.3
1992	0	464.3	69.5	533.8	281.3	55.8	337.1	64.8	935.7
1993	0	480.4	68.1	548.5	291.0	54.6	345.6	64.8	958.9
1994	0	454.9	58.3	513.2	275.6	46.8	322.4	64.8	900.4
1995	0	395.0	60.8	455.9	239.3	48.8	288.1	64.8	808.8
1996	0	329.4	52.9	382.3	199.5	42.5	242.0	64.8	689.1
1997	0	267.3	48.1	315.4	160.4	38.5	198.9	64.8	579.1
1998	0	219.2	41.8	261.0	131.5	33.5	165.0	64.8	490.8
1999	0	180.9	38.7	219.6	108.5	30.9	139.4	64.8	423.8
2000	0	147.7	33.5	181.0	88.6	26.8	115.4	64.8	361.2

*Assumes 61 percent state ownership
**Due to pipeline tariff reduction
***Revenues on a calendar year basis

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: Based on production estimates, Dames and Moore, 1978.

population, will all increase as a consequence of the development, al-though these effects are captured endogenously within the model.

Offshore Prudhoe Bay (Low Discovery Case)

The second scenario examined involves activities surrounding a smaller level of resource discoveries in the same area as assumed for the first scenario. In this case, it is assumed that .8 billion barrels of oil and 1.6 trillion cubic feet of gas are discovered in the offshore area around Prudhoe Bay.

Exploration activity in this scenario begins in 1980, as does the construction of required facilities. Construction employment peaks in 1987 with 855 workers, declining shraply thereafter; by 1994 construction requirements amount to only 5 workers. Petroleum sector employment peaks at 737 workers in 1994, eventually declining to 497 by 1998, with 85 percent of this work force at the North Slope site and the remaining 15 percent in Anchorage. Table 3.5 presents the complete schedule of direct employment requirements.

Oil and gas production in this scenario begins in 1989, with production peaking in 1996 at .193 billion barrels of oil and 220 million cubic feet of gas per year. Table 3.6 presents the complete production schedule for the scenario.

Qualitatively, the impact of the Prudhoe (Low) development on state petroleum revenues is similar to the larger discovery scenario, although

TABLE 3.5. DIRECT EMPLOYMENT REQUIREMENTS
-PRUDHOE (LOW) SCENARIO-

Year	Petroleum Sector			Construction Sector	Total		
	Region 1	Region 5	State	(Region 1 only)	Region 1	Region 5	State
1979	0	0	0	0	0	0	0
1980[1]	60	6	66	0	60	6	66
1981	108	11	119	61	169	11	180
1982	92	11	103	18	110	11	121
1983	33	11	44	86	119	11	130
1984	33	11	44	86	119	11	130
1985[2]	16	11	27	67	83	11	94
1986	16	11	27	247	263	11	274
1987	148	24	172	855	1003	24	1027
1988	264	36	300	592	856	36	892
1989[3]	558	65	623	264	822	65	887
1990	558	65	623	83	641	65	706
1991	564	66	630	83	647	66	713
1992	570	66	636	30	600	66	666
1993	576	67	643	83	659	67	726
1994	662	75	737	5	667	75	742
1995	662	75	737	5	667	75	742
1996	602	75	677	5	607	75	682
1997	542	75	617	5	547	75	622
1998	542	75	617	5	547	75	622
1999	422	75	497	5	427	75	502
2000	422	75	497	5	427	75	502

[1] Exploration begins
[2] Development begins
[3] Production begins

Region 1 - North Slope
Region 5 - Anchorage

SOURCE: Dames and Moore, 1978

TABLE 3.6. PRODUCTION SCHEDULE
-PRUDHOE (LOW) SCENARIO-

Year	Oil (MMBD)	Gas (MMCPD)
1989	.0479	220
1990	.1064	220
1991	.1367	220
1992	.1700	220
1993	.1770	220
1994	.1841	220
1995	.1928	220
1996	.1930	220
1997	.1865	220
1998	.1775	220
1999	.1577	220
2000	.1297	220

SOURCE: Dames and Moore, 1978

the timing and magnitude of such effects vary. The maximum effect on annual state petroleum revenues occurs in 1997 with a total increase of $373 million, 13 percent from increased property taxes, 33 percent from increased production taxes, and 54 percent from royalties. Table 3.7 presents a complete schedule of these revenue effects.

Camden-Canning Scenario

The third scenario examined involves a discovery to the east of Prudhoe Bay in the area of Camden Bay and the Canning River. It also falls within the boundary of the joint state/federal lease sale. In this case, it is assumed that 1.3 billion barrels of oil and 3.25 trillion cubic feet of gas are discovered.

Exploration and construction activities in this case do not begin until 1982. Construction employment peaks in 1988 at 1200 workers, then declines sharply until reaching a permanent force of 5 persons in 1998. Petroleum sector employment peaks in 1992 at 1110 workers, declining slowly to a permanent contingent of 801 by 1999, with 87 percent of this employment in the North Slope Borough and 13 percent in Anchorage. Table 3.8 presents a complete schedule of direct employment requirements.

Oil and gas production begins in 1990, reaching a peak production of .3378 million barrels of oil and 360 million cubic feet of gas per day by 1995. The complete production schedule is presented in Table 3.9.

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TABLE 3.7. DIRECT EFFECTS ON STATE PETROLEUM REVENUES***
-PRUDHOE (LOW) SCENARIO-
(millions of $)

Year	Bonus Payments	Royalty Payments			Production Taxes			Property Tax	Total
		From New* Production	From Old** Production	Total	From New* Production	From Old** Production	Total		
1979	0	0	0	0	0	0	0	0	0.0
1980[1]	125	0	0	0	0	0	0	0	125.0
1981	125	0	0	0	0	0	0	0.7	125.7
1982	0	0	0	0	0	0	0	0.9	0.9
1983	0	0	0	0	0	0	0	2.0	2.0
1984	0	0	0	0	0	0	0	3.2	3.2
1985[2]	0	0	0	0	0	0	0	4.2	4.2
1986	0	0	0	0	0	0	0	7.9	7.9
1987	0	0	0	0	0	0	0	20.7	20.7
1988	0	0	0	0	0	0	0	30.9	30.9
1989[3]	0	30.7	28.7	59.4	18.8	23.1	41.9	36.6	137.9
1990	0	68.7	25.8	94.5	41.7	20.7	62.4	39.7	196.6
1991	0	93.3	25.1	118.4	56.6	20.1	76.7	43.1	238.2
1992	0	123.1	24.1	147.2	74.6	19.3	93.9	46.0	287.1
1993	0	136.2	23.5	159.7	82.6	18.9	101.5	49.9	311.1
1994	0	150.7	20.0	170.7	91.4	16.0	107.4	49.9	328.0
1995	0	167.8	20.9	188.7	81.5	16.8	98.3	49.9	336.9
1996	0	178.2	18.2	196.4	108.0	14.7	122.7	49.9	369.0
1997	0	183.0	16.6	199.6	109.8	13.3	123.1	49.9	372.6
1998	0	185.0	14.5	199.5	111.0	11.6	122.6	49.9	372.0
1999	0	174.7	13.4	188.1	104.9	10.8	115.7	49.9	308.7
2000	0	152.5	11.6	164.1	91.6	9.3	100.9	49.9	314.9

*Assumes 64 percent state ownership
**From pipeline tariff reduction
***Revenues on a calendar year basis

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: Based on production schedules from Dames and Moore, 1978.

TABLE 3.8. DIRECT EMPLOYMENT REQUIREMENTS
-CAMDEN-CANNING SCENARIO-

Year	Petroleum Sector Region 1	Petroleum Sector Region 5	Petroleum Sector State	Construction Sector (Region only)	Total Region 1	Total Region 5	Total State
1979	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0
1982[1]	76	8	84	12	88	8	96
1983	92	9	1 01	52	1 44	9	1 53
1984	108	11	119	30	138	11	149
1985	49	11	60	61	110	11	121
1986[2]	49	11	60	224	273	11	284
1987	49	11	60	649	698	11	709
1988	105	16	121	1200	305	16	321
1989	280	34	314	754	1034	34	1068
1990[3]	690	75	765	581	1271	75	1346
1991	822	88	910	303	1125	88	1213
1992	1004	106	1110	83	1087	106	1193
1993	1010	107	1117	0	1010	107	1117
1994	1010	07	1117	83	1093	07	1200
1995	976	07	1083	13	1089	07	1196
1996	868	07	975	0	868	07	975
1997	814	07	921	83	897	07	1004
1998	754	07	861	5	759	07	866
1999	694	07	801	5	699	07	806
2000	694	0	801	5	699	07	806

[1] Exploration begins
[2] Development begins
[3] production begins

Region 1 - North Slope
Region 5 - Anchorage

SOURCE: Dames and Moore, 978

TABLE 3.9. PRODUCTION SCHEDULE
-CAMDEN-CANNING SCENARIO-

Year	Oil (MMBD)	Gas (MMCPD)
1990	.0630	360
1991	.1650	360
1992	.2320	360
1993	.2887	360
1994	.3213	360
1995	.3378	360
1996	.3356	360
1997	.3171	360
1998	.2824	360
1999	.2419	360
2000	.2127	360

SOURCE: Dames and Moore, 1978

Although the production of oil and gas in this scenario is spread over a longer period than the large discovery Prudhoe case, so that production rates are much lower throughout the early years of production, the larger state share in the ownership of the Camden-Canning field results in revenue impacts similar to those of the Prudhoe (High) scenario. The maximum increase in annual state petroleum revenues occurs in 1996 with an increase of $875 million, 12 percent of increased property taxes, 34 percent from increased production taxes, and 54 percent from increased royalties. Table 3.10 presents a breakdown of revenue effects for the Camden-Canning scenario.

Cape Halkett Scenario

The final scenario examined is associated with development of an area east of Prudhoe Bay in the Cape Halkett area, within the boundaries of a currently unscheduled federal lease sale assumed to be held in 1984. It is assumed that .8 billion barrels of oil are discovered in the Cape Halkett area.

Exploration activity is assumed to begin in 1984, with facility construction commencing in 1985. Construction employment peaks at 818 in 1990, declining to a nominal crew of 5 workers by 1993. Petroleum sector employment peaks at 554 by 1994, declining slowly to 454 by 1999, 12 percent in Anchorage and 88 percent in the North Slope Borough. Table 3.11 presents the schedule of direct employment requirements.

TABLE 3.10. DIRECT EFFECTS ON STATE PETROLEUM REVENUES***
-CAMDEN-CANNING SCENARIO-
(millions of $)

Year	Bonus Payments	Royalty Payments: From New* Production	Royalty Payments: From Old** Production	Royalty Payments: Total	Production Taxes: From New* Production	Production Taxes: From Old** Production	Production Taxes: Total	Property Tax	Total
1979		0	0	0	0	0	0	0	0.0
1980	1:5	0	0	0	0	0	0	0	125.0
1981[1]	125	0	0	0	0	0	0	0	125.0
1982	0	0	0	0	0	0	0	.2	.2
1983	0	0	0	0	0	0	0	.8	.8
1984	0	0	0	0	0	0	0	1.3	1.3
1985	0	0	0	0	0	0	0	2.2	2.2
1986[2]	0	0	0	0	0	0	0	5.8	5.8
1987	0	0	0	0	0	0	0	16.6	16.6
1988	0	0	0	0	0	0	0	38.0	38.0
1989	0	0	0	0	0	0	0	53.3	53.3
1990[3]	0	63.6	61 .3	124.9	38.4	49.3	87.7	67.0	279.6
1991	0	161.5	59.6	221.1	97.8	47.9	145.7	75.9	442.7
1992	0	237.8	57.1	294.9	144.0	45.9	189.9	81.7	566.5
1993	0	312.1	55*7	367.8	189.0	44.8	233.8	85.9	687.5
1994	0	368.0	46.9	414.9	222.9	37.7	260.6	91.9	767.4
1995	0	409.9	49.2	459.1	248.3	39.5	287.8	99.3	846.2
1996	0	431.8	42.8	474.6	261.6	34.5	296.1	104.5	875.2
1997	0	412.9	39.4	452.3	247.7	31.5	279.2	111.8	843.3
1998	0	409.6	34.3	443.9	245.6	27.4	273.1	111.8	828.8
1999	0	372.5	32.0	404.5	223.4	25.6	249.0	111.8	765.3
2000	0	347.5	27.6	375.1	208.4	22.1	230.5	111.8	717.4

*Assumes 87 percent state ownership
**From pipeline tariff reduction
***Revenues on a calendar year basis

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE: Based on production estimates, Dames and Moore, 1978

TABLE 3.11. DIRECT EMPLOYMENT REQUIREMENTS
-CAPE HALKETT SCENARIO-

Year	Petroleum Sector			Construction Sector	Total		
	Region 1	Region 5	State	(Region 1 only)	Region 1	Region 5	State
1984[1]	30	3	33	0	30	3	33
1985	62	6	68	21	83	6	89
1986	79	8	87	34	113	8	121
1987	16	8	24	13	29	8	
1988[2]	16	8	24	119	135	8	1:;
1989	16	8	24	416	432	8	440
1990	66	13	79	818	884	13	897
1991	132	20	152	474	606	20	626
1992[3]	492	55	547	35	527	55	582
1993	492	55	547	5	497	55	552
1994	498	56	554	5	503	56	559
1995	498	56	554	5	503	56	559
1996	498	56	554	5	503	56	559
1997	458	56	514	5	463	56	519
1998	458	56	514	5	463	56	519
1999	398	56	454	5	403	56	459
2000	398	56	454	5	403	56	459

[1] Exploration begins
[2] Development begins
[3] Production begins

Region 1 - North Slope
Region 5 - Anchorage

SOURCE: Dames and Moore, 1978

Production at the site begins in 1992, peaking at .2599 million barrels per day by 1997. Table 3.12 presents the production schedule for the Cape Halkett case.

Because the Halkett development occurs on exclusively federal properties, the effects on state petroleum revenues are much more limited than in the previous scenarios. The state receives neither bonuses, royalties nor production taxes from any new production originating from an exclusively federal sale area. However, the state may still tax any facilities located within three miles of shore or onshore, and to the extent that such new production flows through TAPS and ALCAN, it will reduce tariffs and increase the wellhead value, and therefore royalties and production taxes, from production on state lands. This effect on the value of existing production, combined with new property taxes, amounts to an increase of as much as $60 million annually by 1996, with over 47 percent of this effect due to the property tax, 24 percent due to increased production taxes, and 29 percent due to increased royalties. A breakdown of the complete schedule of revenue effects is given in Table 3.13.

TABLE 3.12. PRODUCTION SCHEDULE
-CAPE HALKETT SCENARIO-

Year	Oil (MMBD)	Gas (MMCPD)
1992	.0538	0
1993	.1272	0
1994	.1747	0
1995	.2272	0
1996	.2573	0
1997	.2599	0
1998	.2409	0
1999	.2074	0
2000	.1636	0

SOURCE: Dames and Moore, 1978

TABLE 3.13. DIRECT EFFECTS ON STATE PETROLEUM REVENUES***
-CAPE HALKETT SCENARIO-
(millions of $)

Year	Bonus Payments	Royalty Payments			Production Taxes			Property Tax	Total
		From New* Production	From Old** Production	Total	From New* Production	From Old** Production	Total		
1985[1]	0	0	0	0	0	0	0	.3	.3
1986	0	0	0	0	0	0	0	.7	.7
1987	0	0	0	0	0	0	0	.9	.9
1988[2]	0	0	0	0	0	0	0	2.6	2.6
1989	0	0	0	0	0	0	0	8.6	8.6
1990	0	0	0	0	0	0	0	21.2	21.2
1991	0	0	0	0	0	0	0	29.6	29.6
1992[3]	0	0	20.2	20.2	0	16.3	16.3	31.7	68.2
1993	0	0	19.4	19.4	0	15.7	15.7	31.7	66.8
1994	0	0	14.4	14.4	0	1.6	11.6	31.7	57.7
1995	0	0	15.7	15.7	0	2.7	12.7	31.7	60.1
1996	0	0	13.9	13.9	0	1.2	11.2	31.7	56.8
1997	0	0	13.5	13.5	0	0.8	10.8	31.7	56.0
1998	0	0	11.9	11.9	0	9.6	9.6	31.7	53.2
1999	0	0	11.8	11.8	0	9.4	9.4	31.7	52.9
2000	0	0	10.3	10.3	0	8.2	8.2	31.7	50.2

*No revenues from new production, since field is exclusively federal
**From pipeline tariff reduction
***Revenues on a calendar year basis

[1] Exploration begins in 1984
[2] Development begins
[3] Production begins

SOURCE: Based on production estimates, Dames and Moore, 1978

Economic Impacts of Beaufort Sea OCS Development

OCS development in the Beaufort Sea will lead to changes in those factors which have previously been isolated as important causes of growth--exogenous employment, personal income, and state expenditures. The change in these factors will result in changes in population, the state's fiscal picture, the structure of employment, and the regional distribution of population and employment. These changes are the economic impacts of OCS development. This section will explore the impact on the Alaska economy of OCS development.

We will examine the impact of each of the four separate development scenarios discussed above. The impact of each of these will vary, since the scenarios vary in terms of their primary employment impact, timing, and the revenues which accrue to the state. For the most part, only the impacts will be discussed. The impacts will be measured as changes from the base case described in Chapter II. By examining only these changes, we can consider the impacts of Beaufort development as separate from the assumptions made in the base case.

Impacts were estimated by making runs of the MAP model, which included the assumption of each scenario, then comparing the results to the base case. One important assumption must be made in this type of analysis. It must be assumed that the economy responds the same to employment and revenues generated by Beaufort OCS development as it did to similar changes in the past. This is the implicit assumption which underlies the use of econometric models for projection and impact analysis, since these models are estimated from the past.

The approach which will be taken in the following analysis is to ask six questions concerning the changes which result from OCS development in each scenario. Answers to these questions will provide a description of the economic impact of this development. The questions are as follows:

1. How is the growth of each of the aggregate indicators affected by OCS development? These indicators include employment, population, personal income, and state expenditures.

2. What are the significant causes of the changes of these indicators? The question will attempt to assess the importance of exogenous employment changes and changes in state spending on growth.

3. How do the additional revenues change the fiscal picture of the state? This question will examine whether the OCS development leads to increased services and what its affect is on fund balances.

4. Does the composition of the change in employment differ from the base case? This question will examine whether the OCS changes support base case trends in structural changes, seasonality, and unemployment.

5. Does the composition of population change? Will changes because of OCS development support demographic trends in the base case?

6. What are the regional effects of these changes? This question will examine the changes in employment, population, and personal income which result in Anchorage, Fairbanks, and the North Slope because of OCS development.

Prudhoe High Scenario

The Prudhoe High Scenario has the greatest effect en the economy of all the scenarios. Exploration begins in 1979 and lasts until 1983, with peak exploration employment in 1980. Development begins in 1984 and lasts through 1987, with peak development employment in 1986; this is also the peak in direct employment for the entire period. Production begins in 1988 and lasts through the remainder of the forecast period.

AGGREGATE INDICATORS

Table 3.14 shows the impacts of each of the aggregate indicators of economic activity. In each case, these indicators are greater than the base case and the difference grows continually throughout the period. Population is 40,156 greater by 2000 than in the base case. Each stage of OCS activity affects population growth differently. By the end of the exploration phase in 1983, 4.1 percent of the total population impact has been achieved. By 1987, when the development stage ends, 27 percent of the total impact has been reached. The major population impact occurs in the production phase. Population growth rates differ from the base

TABLE 3.14. PRUDHOE HIGH SCENARIO IMPACT ON AGGREGATE INDICATORS
(Measured as Changes from the Base)
STATE OF ALASKA
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)	Total State Expenditures (millions of $)
1979[1]	289	221	8.738	1.293
1980	746	536	23.918	1.629
1981	1,080	718	29.101	11.881
1982	1,465	942	38.453	22.173
1983	1,664	997	42.378	24.114
1984[2]	1,887	1,071	48.019	26.162
1985	2,458	1,410	71.015	30.213
1986	8,618	6,002	355.926	65.931
1987	10,881	6,947	407.227	83.734
1988[3]	13,189	7,910	434.594	118.031
1989	17,086	10,140	563.926	221.092
1990	19,186	10,838	625.918	244.208
1991	21,426	11,646	698.113	270.910
1992	24,198	12,872	790.125	353.839
1993	26,167	13,460	858.676	382.667
1994	27,469	13,571	896.637	405.757
1995	29,403	14,250	980.512	437.683
1996	31,290	14,921	1,070.750	470.207
1997	33,328	15,721	1,177.310	507.098
1998	35,426	16,580	1,294.410	546.090
1999	37,782	17,635	1,435.880	591.312
2000	40,156	18,696	1,587.780	638.793

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Statewide Model

case. During the exploration phase, growth is approximately the same rate as in the base. Population grows about 22 percent faster in the development phase than during the same period for the base case. The growth rate in the production phase is 40 percent higher than during the same period in the base case. By 2000 population is 7 percent greater than in the base case.

Employment experiences the same type of growth pattern, being higher than the base case by 18,696 jobs, or 6.4 percent, by the end of the period. Approximately 6 percent of the impact has been reached by the end of the exploration phase; 37 percent has been reached by the end of development. From 1978, the year before exploration begins, employment grows at an average annual rate of 2.3 percent. This is 19 percent greater than the growth rate in the same period in the base case. Unlike population, the greatest difference is in the development phase, when the growth rate is 2.6 percent compared to 1.9 percent in the base case. The growth rate in the exploration phase is 3 percent greater than for the same period in the base case, and the production phase experiences a growth rate 20 percent greater than in the base case.

Personal income is $1.59 billion higher by 2000 because of the Prudhoe High development. This is 9.2 percent greater than in the base case. Of this impact, 3 percent is achieved during the exploration phase and 23 percent in the development stage. Growth during the entire period averages 7.4 percent per year, which is approximately 7 percent faster than the annual average growth of 6.9 percent during the period 1978-2000 in the base case.

State expenditures are $.639 billion higher by 2000 than in the base case. Total state expenditures are $5.57 billion, compared to $4.94 billion in the base case. Over 86.9 percent of this impact occurs in the production phase of activity, compared with 3.8 percent in exploration and 9.3 percent in development. The annual rate of growth of state expenditures in the production phase is 4.9 percent, which is 17 percent greater than in the base case during the same period.

CAUSES OF GROWTH

The discussion in Chapter II isolated changes in exogenous employment, changes in personal income, and changes in state expenditures as the major causes of growth. Changes in these same variables are responsible for generating impacts over the base case. The most important causes of the changes discussed above are changes in exogenous construction and mining employment, which result from the Beaufort development, and changes in state expenditures. Each of these effects is dominant in different periods of the analysis. The importance of the level of Beaufort OCS employment and the associated changes in personal income are more important during the exploration and development stages. At its peak in the third year of development, exogenous employment accounts for 31 percent of the total emp" oyment impact. By 2000, although Beaufort OCS employment is still high at 940, it accounts for only 5 percent of total employment.

State expenditures are greater than in the base case from the beginning of exploration work in 1978. Expenditures increase for two reasons. First, increases in population will lead to increased expenditures as state services are extended to this new population. Second, state expenditures increase as additional revenues are earned from petroleum development. The same spending rule operates in the OCS scenarios as in the base case: 60 percent of petroleum royalties and 100 percent of bonuses are saved and all other revenues are spent; the savings rate is reduced or dissavings takes place in order to maintain the level of real per capita expenditures. The importance of this rule is that it presents another way in which OCS development affects state growth. OCS development produces revenues which increase state spending, which in turn affects economic growth. The importance of this effect lasts throughout the period because revenue increases generate permanent increases in per capita state expenditures. The expenditure impact is much greater in the production period when the flow of oil, which produces both royalties and severance taxes, begins and provides large increases in revenues over the base period. These revenue increases cause expansion of the level of services provided by the state and, therefore, expenditures. During this same period, exogenous Beaufort Sea production employment is reduced. These two effects make the expenditure impact more important.

The overall proportion of impact which results from either of these causes is hard to determine. Interaction between these state expenditures and employment and the dynamic nature of the economy prevent separation. One way to estimate the proportion of impact caused by each factor is to examine what would happen to the major variables if state expenditures remained as . n the base case. This is not a description of what will happen, because state expenditures, as we have shown, will undoubtedly respond to increases in revenues. This test allows us to see in some sense the direct impact of development following the Prudhoe High Scenario. The sensitivity analysis in Chapter IV was undertaken to show this. By 2000 private development is responsible for 38 percent of the population impact, 32 percent of the employment impact, and 36 percent of the impact on incomes. Slightly less than two-thirds of the Prudhoe High impact on all aggregate indicators is a result of increased state expenditures.

FISCAL IMPACTS

Table 3.15 illustrates the changes in the state fiscal posture. The development of the Beaufort OCS according to the Prudhoe High Scenario improves the overall state fiscal position during the forecast period. By 2000 there is $7.7 billion more in the permanent fund than in the base case. One reason for this is that after production begins in 1988 the change in revenues resulting from Beaufort development exceeds the change in expenditure.

The change in total revenues because of OCS development is importantly affected by production. Prior to the production stage, the increase in revenues results from three sources, increases in the property taxes, increases in non-petroleum taxes, and bonuses paid to the state for leases in the state's portion of the OCS area. The first major increase

TABLE 3.15. IMPACT ON THE STATE FISCAL SECTOR OF THE PRUDHOE HIGH SCENARIO
(Measured as Changes from the Base)
(in Millions of Dollars)
STATE OF ALASKA
1979-2000

Year	Total Revenues	General Fund Balance	Permanent Fund Balance	Total Expenditures
1979[1]	0.257	-0.925	0.000	1.293
1980	126.338	-0.925	125.000	1.629
1981	136.453	-0.924	250.000	11.881
1982	21.580	-0.923	250.000	22.173
1983	23.431	-0.923	250.000	24.114
1984[2]	25.373	-0.923	250.000	26.162
1985	29.149	-0.923	250.000	30.213
1986	53.469	-9.343	250.000	65.931
1987	93.841	5.903	250.000	83.734
1988[3]	238.795	89.540	293.441	118.031
1989	477.152	230.821	416.621	221.092
1990	682.060	487.773	607.121	244.208
1991	886.073	597.322	1,123.690	270.910
1992	1,068.580	597.324	1,851.100	353.839
1993	1,184.520	596.135	2,668.160	382.667
1994	1,229.420	464.466	3,638.510	405.757
1995	1,218.210	179.654	4,720.350	437.683
1996	1,175.870	0.000	5,623.700	470.207
1997	1,119.900	0.000	6,256.240	507.098
1998	1,074.530	0.000	6,806.270	546.090
1999	1,046.020	0.000	7,284.710	591.312
2000	1,027.050	0.000	7,698.950	638.793

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE: MAP Statewide Model

in revenues results from the bonuses paid in 1980 and 1981. These revenues, according to the state's expenditure policy, go into the permanent fund; however, interest on these funds generates useable revenues. By the end of exploration in 1983, property tax revenues increase to $2.9 million because of additional equipment and facilities required in exploration. The greatest proportion of increased revenues during exploration results from interest earned on the permanent fund balance; only 12.4 percent of the change in total revenues by the end of the exploration period is because of increased petroleum activity. At this time revenues are only about 1 percent greater than in the base case.

The development of the fields which occurs from 1984 to 1987 increases property tax revenues to $51.3 million over the end of the exploration phase. Revenues from petroleum development have increased to approximately 55 percent of the increase in total revenues by the end of development in 1987. Petroleum revenues increase dramatically once production begins. Petroleum revenues directly associated with the Beaufort OCS development rise to a peak of $947.3 million in 1993, the year following the peak in production; at their peak, petroleum revenues from the Beaufort account for 80 percent of the increase in revenues. The share of petroleum revenues in the Beaufort-induced total revenues falls through the remainder of the period; by 2000 it accounts for only 38 percent of the total. As petroleum production declines, petroleum revenues fall from a peak of $958.9 million to $392.5 million by 2000. (Appendix C has detailed revenue source information.)

The development of the Beaufort OCS according to the Prudhoe High Scenario has two separate impacts on the fiscal posture of the state. First, as discussed above, it increases revenues. Second, it will affect state expenditures. As new population is drawn into the state because of this development, expenditures will be increased to provide a given level of services to the increased population. The increased revenues may also lead to increases in the level of services provided, which will increase expenditures greater than the proportionate increase in population. Until the final year of the development stage, when property tax revenues increase substantially, the increase in expenditures caused by OCS development exceeds the increased revenues. In the first year of exploration (1979), the increase in population is greater than the increase in revenues, and the general fund must be drawn down to maintain per capita expenditures. Until 1986 revenue growth exceeds population enough to maintain modest increases in the real per capita level of services without drawing down the fund balances. The population increases, associated with the final years of development when direct Beaufort employment increases more than sixfold, lead to an approximate $9 million drawdown of the general fund. After production begins, the revenue increase exceeds expenditure increases throughout the remainder of the period. This slows the rate of decrease in the general fund and allows a build-up of the permanent fund.

What is the overall effect of Prudhoe High development on the Alaska state government fiscal position? First, development allows an expansion of services provided residents. Real per capita state expenditures are $66 greater by the end of the period than in the base case. The major increase in services comes in the second year of production when the level of per capita expenditures increases to $43 over the base case. In 1992, the peak production year, real per capita expenditure increases to $66 over the base. By 2000 the level of services is greater than in the base case; real per capita expenditures are $1,705 per person, which is about 4 percent more than in the base case. More importantly, the extra Beaufort revenues have postponed the period when expenditures exceed revenues, until 1997, which is six years later than in the base case. After 1997 expenditures once again are greater' than revenues. What is important here is that the eventuality of the drawdown of the fund balances as expenditures exceed revenues has only been postponed, not eliminated. The problem is the same as in the base case--the cyclical nature of petroleum revenues and expenditure responses to increases in revenues.

INCOME

The increase in personal income due to Beaufort OCS development can have two effects. First, higher levels of personal income will increase the demand for goods and services and lead to growth in the economy. Increase in personal income will have a greater impact on those industries which serve local markets. Second, Beaufort OCS development could lead to welfare increases. Personal income can increase because of increases in the number of workers with the same wage or increasing wages for workers. To the extent the second effect dominates, welfare will be increased. The extent to which these personal income changes will have these effects will be determined by the increased taxes paid and the increase in prices, which reduces the amount of goods and services an extra dollar of income can buy.

Table 3.16 shows the effect of taxes and prices on the increase in personal income generated by OCS development. By 2000 personal income would be $1.59 billion higher with Beaufort OCS development following the Prudhoe High Scenario than in the base case. Progressive taxation at both the state and federal levels would be expected to increase the tax share because of higher incomes. Taxes take almost 25 percent of this incremental income. Prices have a much larger effect on income available to the population. Price increases resulting from Beaufort development affect not only the additional income, but all income. To the extent prices rise because of OCS development, the effect of the added income will be reduced, and there will be a general decrease in the buying power of all income. By 2000 the impact on disposable personal income is reduced by 16 percent because of price increases.

Welfare, as measured by the increase in real per capita disposable incomes (DIRPA), increases because of OCS development. By 2000 DIRPA is about $12 greater than in the base case. The maximum difference during the period is in 1986, when DIRPA is $75 greater. The change in this difference has a great deal to do with the composition of employment. The greatest differences are achieved during the development stage, when high wage construction and petroleum employment in the Beaufort rise to

TABLE 3.16. INCOME IMPACTS OF PRUDHOE HIGH DEVELOPMENT
(Measured as Changes from the Base)
STATE OF ALASKA
1979-2000

Year	Per Capita Real Disposable Income	Disposable Personal Income (Millions of $)	Real Disposable Personal Income (Millions of $)
1979[1]	2.854	6.799	2.130
1980	6.449	18.523	5.511
1981	5.341	22.527	6.305
1982	7.407	29.886	8.292
1983	7.077	32.906	8.873
1984[2]	6.995	37.281	9.750
1985	11.133	54.968	14.037
1986	75.497	273.340	68.774
1987	72.615	313.277	76.033
1988[3]	59.786	334.703	77.852
1989	67.859	434.344	97.444
1990	64.263	481.328	104.694
1991	60.186	536.785	112.960
1992	56.255	606.324	123.270
1993	49.294	658.777	129.614
1994	38.269	686.637	130.808
1995	32.775	750.332	138.315
1996	28.226	817.184	145.957
1997	23.695	897.453	155.105
1998	19.640	983.723	164.593
1999	15.695	1,089.460	176.226
2000	11.746	1,200.650	187.856

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE: MAP Statewide Model

1,859. The importance of this employment can be seen by examining the changes which result from decreasing the level of this employment. Each time employment in the Beaufort is reduced, the difference in per capita income over the base falls. The general decline in the difference by 2000 is a result of a reduction in the importance of this high wage employment sector after the beginning of petroleum production.

EMPLOYMENT

While the primary employment levels associated with OCS development have substantial effects, they also generate significant secondary impacts throughout the state economy. The increase in the demand for goods and services, which results because of changes in the level of personal income, lead to increases in employment in other sectors of the economy. State expenditures, which rise because of the increased revenues available from OCS development, also generate demand for goods and services and increases in employment. The effect on total employment has been discussed above; an equally important effect is on the growth of separate sectors. The change which results will affect the structure of employment. Table 3.17 shows the distribution of this employment between industrial sectors. In the base case, the general trend in the structure of employment which was observed was an increase in the proportion of total employment in the local serving sector, particularly trade and services. The extra employment which results from OCS development in the Prudhoe High Scenario supports this base case trend. We will examine the structure of this increased employment at three points in time, the end of the forecast period, the end of the exploration, and the end of the

TABLE 3.17. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE HIGH EMPLOYMENT IMPACT
(measured as changes from the base)
ALASKA

	1983		1987		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	130	13.0	1,722	24.8	900	4.8
Other Construction	64	6.4	405	5.8	1,546	8.3
Trade	196	19.7	1,531	22.0	4,952	26.5
Services	194	19.5	1,553	22.4	5,333	28.5
Finance	49	4.9	385	5.5	1,291	6.9
Transportation	38	3.8	276	4.0	758	4.1
State and Local Govt.	280	28.1	752	10.8	3,056	16.3
Other*	46	4.6	323	4.6	861	4.6

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Statewide Model

development period. The distribution of employment in 2000 supports the overall trend found in the base case. Trade, services, and finance make up 62 percent of the increased employment, mining and exogenous construction account for only 5 percent, while state and local government account for 16 percent. These percentages are fairly stable during all stages of petroleum activity. The major change is the declining proportion of employment change accounted for by direct Beaufort employment. The other major change is the growth in the importance of state and local government. After an initial period during exploration when it is dominant, state government is only 11 percent of the increase in employment by the end of the development stage. In the production stage, large increases in petroleum revenues increase state expenditures. By the year 2000, state and local government is 16 percent of the total change in employment.

By the end of the production phase, the structure of employment found in the base case is reinforced by the OCS development. This should mean that the reduction in seasonality will take place as discussed in the base case. The increased proportion of employment in non-seasonal industries should reduce the overall seasonality in the economy. Direct employment in the OCS development does have a seasonal component (Dames and Moore, 1978). This should dampen the effect, but not prevent the decrease in seasonality. Even in its peak year, over 50 percent of the increased employment is in non-seasonal industries.

Will OCS development increase or decrease unemployment? In the base case a possible trend toward a reduction in unemployment was assumed because of the decrease in the ratio of population to employment. Although this does not guarantee a reduction, it indicates the possibility of a decrease. The OCS development will support this trend if the ratio of change in population to change in employment falls. This ratio initially rises throughout the exploration phase, then falls when peak employment is reached. It rises throughout the production phase until it reaches 2.14 in 2000; this is higher than the ratio found in 1977. This indicates the impact employment leads to greater increases in population and a possible increase in unemployment.

POPULATION

By 2000 population is 7 percent higher because of development in the Beaufort OCS. The greatest increase in population occurs in 1986, when the extra population increases 6,000 as a result of peak increases in direct OCS employment. The major factor changing this is the greater levels of migration experienced because of OCS. Since migration is a response to increased employment opportunities and income, the increase in migration is not surprising. Immigration resulting from OCS development is not large enough to eliminate the general outmigration which occurs throughout the period. The effect of OCS development is to reduce outmigration. In the period between 1986 and 1998, which is dominated by outmigration in the base period, increased employment opportunities associated with OCS developement lead to immigration -n only four years. Only in 1986 is this substantial, with an immigration of approximately 5,800. The reduction in the **outmigration** is responsible for the increased population.

Since migration is not assumed to affect Native population, one impact of this increase is a reduction in the share of Native population in the total. By 2000 Native population is 17 percent of the total, compared to 19 percent in the base case; this is approximately the same as the Native share of total population in 1977,

The structure of population will be changed in the OCS case. Migration response to changing economic opportunities most importantly affects the young. The reduction in **outmigration** would be assumed to dampen the aging in the population structure found in the base case. Table 3.18 shows the proportion of each age-sex classification in the total population in 1980, 1990, and 2000. By 2000 the age structure has still undergone aging, although not quite as rapid as in the base case. By 2000 the proportion of population which is greater than forty is 4 percent less than in the base case. This age cohort, although it increases, increases at a slower rate than the total population.

Regional Impacts

This section will examine the impact of OCS development on three regions, the North Slope, Anchorage, and Fairbanks. The impacts of OCS development will be measured as changes in the population, employment, and personal income growth in each region from the base case discussed in

TABLE 3.18. AGE-SEX STRUCTURE OF THE POPULATION
PRUDHOE HIGH SCENARIO
(% of total population)

	1980		1990		2000	
	Male	Female	Male	Female	Male	Female
0 - 1	1.19	1.19	1.08	1.08	1.03	1.03
1 - 4	4.28	4.09	4.23	4.02	3.84	3.65
5 - 9	4.74	4.64	5.05	4.91	4.65	4.50
10 - 14	4.32	4.22	4.46	4.31	4.37	4.21
15 - 19	4.93	4.11	4.10	3.80	4.25	3.91
20 - 24	8.58	5.70	5.76	3.97	5.63	4.11
25 - 29	6.01	5.24	4.63	3.97	3.95	3.64
30 - 34	4.67	4.27	4.63	4.13	3.65	3.43
35 - 39	3.60	3.21	4.38	3.76	3.70	3.24
40 - 44	2.54	2.41	3.52	3.27	3.44	3.16
45 - 49	2.04	1.84	2.71	2.55	3.11	2.87
50 - 54	1.78	1.57	2.10	2.01	2.68	2.53
55 - 59	1.48	1.31	1.63	1.58	2.13	2.10
60 - 64	1.18	1.06	1.30	1.29	1.65	1.72
65 +	1.96	1.84	2.74	3.03	3.46	4.36

SOURCE : MAP Statewide Model

Chapter II. OCS development in the Beaufort Sea affects all regions of the state. The impact in any one region which results from OCS development will be determined by the location of exogenous employment, the strength of a region's interaction with directly-impacted regions, and the size of the local economy. Both the North Slope and Anchorage will be directly affected by Beaufort OCS development. Since development occurs in the North Slope region, the increase in exogenous employment will have an important direct effect. The assumed enclave nature of this development will minimize the effect on the local North Slope economy. More important to the growth of all of these regions are those processes of regional interaction previously described, distribution of state expenditures, the effect on wage rates, importance as a trade center, and interregional migration. The distribution of state and local employment is directly related to the distribution of state expenditures. State expenditures are an important source of growth in regions where the direct employment does not occur, such as Fairbanks. The relation between the increased employment in state and local government and the total impact employment is a proxy for the relation between the distribution of state and local expenditures and total impact resulting from the Beaufort OCS development. Growth of construction and mining on the North Slope affects wage rates in all other regions. This increase in wage rates leads to increased personal incomes and demand for goods and services in the region. Both Fairbanks and Anchorage are regional centers which are affected by growth in other regions. Growth in the North Slope affects the Fairbanks economy as it provides goods and services to this region. Anchorage, which serves as the administrative, trade, and financial center for the state, reflects the growth of all regions. Migration has an important effect on the smaller economies; as Anchorage expands rapidly, it attracts population from other areas of the state. The size of the local economy will determine the extent to which any of these factors leads to induced expansion of the economy. Because of scale effects, larger economies will have larger induced growth. This is important for the growth of Anchorage which provides more of the increased demand for goods and services than in smaller regions. These factors are responsible for regional growth and are not changed by OCS development.

NORTH SLOPE REGION

Employment

Tables 3.19 and 3.20 show the changes in North Slope employment over the base case and the industrial distribution of this change. The increase over the base case does not grow smoothly throughout the period, but experiences several small peaks and one large peak. By 2000 total employment is 1,575 greater than in the base, which is about 21 percent higher than the base. When direct employment at the OCS site peaks in the development phase, total employment is 4,464, or 62 percent higher. By the end of the exploration phase in 1983, total employment is only 4 percent higher than in the base.

Employment increases on the North Slope are of two kinds. First, petroleum and construction employment located at Prudhoe Bay are part of the enclave sector which increases with OCS development. This increase has

TABLE 3.19. PRUDHOE HIGH SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
NORTH SLOPE REGION
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979[1]	69	67	3.687
1980	256	249	15.570
1981	146	159	10.204
1982	281	248	17.210
1983	299	254	18.544
1984[2]	349	292	22.575
1985	725	620	51.597
1986	5,012	4,464	401.792
1987	4,813	4,087	375.017
1988[3]	1,700	1,450	123.754
1989	1,577	1,509	134.243
1990	1,514	1,533	143.062
1991	1,488	1,568	154.769
1992	1,329	1,466	152.033
1993	1,309	1,451	159.115
1994	1,197	1,341	154.758
1995	1,219	1,356	164.879
1996	1,263	1,389	178.019
1997	1,308	1,426	192.884
1998	1,348	1,470	209.398
1999	1,393	1,520	228.351
2000	1,436	1,575	249.198

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Regional Model

TABLE 3.20. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE HIGH EMPLOYMENT IMPACT
(measured as changes from the base)
NORTH SLOPE REGION

	1983		1987		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	119	46.7	1,686	41.3	821	52.1
Other Construction	105	41.2	2,045	50.0	454	28.8
Trade	2	.8	25	.6	19	1.2
Services	10	3.9	134	3.3	91	5.8
Finance	1	.4	19	.5	13	.8
Transportation	9	3.5	128	3.1	104	6.6
State and Local Govt.	8	3.1	44	1.1	61	3.9
Other*	1	.4	6	.1	12	.8

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

only minimal impact on the local economy. Second, increases in employment at Prudhoe Bay lead to increases in the local economy because local and state government revenues and expenditures will increase, which will lead to increases in the local economy. Personal incomes will also rise in the local economy because of a general expansion in wage rates, which results from OCS development.

The importance of growth in the local economy can be separated from total growth by examining the distribution of employment between these sectors on the North Slope. The enclave sector actually includes a portion of construction which is not directly related to development, as well as other industries such as transportation. Because this proportion cannot easily be separated, this analysis may overstate the growth of the local economy. During the exploration phase, there is very little effect on the local economy. Of the 255 extra employees in 1983, 47 percent are directly associated with OCS petroleum activity. The local sector of the North Slope economy in the base case consists of4,200 employees in 1983, so during exploration the local sector increases by 3 percent. By the end of the development phase in 1987, the total impact is 4,087; of this 1,833 is in the petroleum enclave sector. At this time in the base case, the local sector is 4,513 employees. The largest impact on the local economy occurs in this development stage with approximately 50 percent increase in the local sector. During production, direct OCS impact employment stabilizes at 821, which is its level in 2000, and is 52 percent of the total employment impact. In the base case, the local sector is about 6,061 in 2000, so that impact increases the local sector employment approximately 12 percent.

The overall distribution of this impact could either reinforce or impede the trend toward increasing importance in the local support sector found in the base case. By far the largest expanding industry is construction, which ranges from 50 percent of the impact at the end of the development stage to 29 percent at the end of the period. The share of the impact in trade, services, and finance increases throughout the period, which supports the trend found in the base case. After construct" on, transportation is the most important sector in the local economy which increases its importance throughout the period as in the base case. Overall, though, the importance of exogenous employment in the employment impact impedes the trend toward the increased importance of the local serving sectors found in the base case. The growth caused by Beaufort development may limit the reduction in seasonality suggested by the structural change forecast in the base case. However, much of the employment in the highly seasonal construction and mining industries is in the enclave sector; Beaufort development may reduce seasonality in the local sector since the local support sector is seen to grow.

Population

Table 3.19 shows the population impact in the three study regions. By 2000 the North Slope Borough population has increased by 1,437 over the base case. This total will not have as large an impact on the local population, since over half of this increase is the extra employment in the enclave sector. The total population in the local sector is only increased by 616 above the base levels; this is an 8 percent increase in population. The population impact by the end of the exploration phase is 181, which is 3.3 higher than the base. The effect on total population is more important in the development stage. By the end of development, the local population is 3,127, or 56 percent higher than in the base.

These population increases have two effects on the North Slope Borough. First, the growth in the economy has the effect of reducing the outmigration of local residents, which has been found to be a past trend in village and rural Alaska (Alonso, 1976). Second, the increase in population at Prudhoe leads to welfare increases by increasing the revenues available to the borough. This increase in revenues can be considered an overall increase in welfare, since, assuming the enclave nature of development, there is no proportional increase in the demand for services.

Personal Income

By 2000 personal income is $249.2 million higher in the North Slope because of Beaufort OCS development. The impact is highest in the second year of construction when incomes are 91 percent higher than in the base case. By the end of exploration, personal income is 5.3 percent higher than the base case. The peak during development shows the importance of the high incomes of construction workers associated with Beaufort development.

ANCHORAGE

Employment

Anchorage has in the past served as the Alaska headquarters for petroleum and petroleum support firms. Because of this past relation, it is assumed that increased petroleum activity on the North Slope will lead to increased support activity in Anchorage. This provides a direct link between the level of OCS development and Anchorage economic growth. Additionally, Anchorage growth is affected by increases in demand for goods and services, which result from increases in the personal income of the region and increased state expenditures. Anchorage serves as a supply source for many goods and services for the rest of the state; because of this, Anchorage will experience growth as demand in the rest of the state increases.

Total employment in Anchorage is 14,201 greater than in the base case by 2000; this is an 8.4 percent increase in employment over the base. By the end of the exploration phase in 1983, employment in Anchorage is 485, or .5 percent higher than in the base, and by the end of development, employment is 3,616, or 3.2 percent higher. The importance of impact-associated employment increases throughout the period.

The development of the Beaufort OCS according to the Prudhoe High Scenario increases the growth rate from 3.1 percent in the base case to 3.5 percent per year between 1977 and 2000. The relation between the growth rates in the base case and with Beaufort development is consistent throughout the forecast period. Average annual growth of total employment averages about 12 percent more in both the exploration-development and production phases.

The composition of the extra employment which results from OCS development supports the structural changes found in the base case. Between 1977 and 2000 the base case saw an expansion of the importance of the Anchorage local service sector, particularly trade and services. By examining the structural component of this extra employment, we can see this trend is supported. In all phases, exploration, production, and development, trade, services, and finance are more than 50 percent of the impact. Tables 3.21 and 3.22 show the employment trends in Anchorage. The Beaufort impact should also support the reduction in seasonality of the Anchorage economy suggested by the structural change in the base case.

Population

The development of the Beaufort OCS according to the Prudhoe High Scenario increases the concentration of population in Anchorage. By 2000 population is 28,097 higher in Anchorage than in the base case; this is almost 9 percent greater than in the base case. The majority of this impact occurs in the production period. By the end of exploration, population is less than 1 percent higher than in the base case. Population is 2.3 percent higher than in the base case because of OCS development by the end of the development phase in 1987. By 2000 the population impact in Anchorage is 70 percent of the total impact in the state; this is greater than the 56 percent of total state population in Anchorage in 2000 in

TABLE 3.21. PRUDHOE HIGH SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
ANCHORAGE
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979[1]	150		2.426
1980	353	1;;	5.994
1981	570	292	9.675
1982	758	446	14.867
1983	866	484	16.844
1984[2]	987	531	19.308
1985	1,255	729	27.799
1986	4,219	3,115	125.919
1987	5,554	3,616	152.142
1988[3]	7,890	3,780	169.753
1989	10,274	5,025	230.582
1990	11,635	5,477	260.485
1991	13,136	6,100	300.098
1992	14,942	7,058	356.410
1993	16,332	7,626	399.121
1994	17,312	8,018	433.242
1995	18,775	8,722	488.266
1996	20,255	9,427	547.160
1997	21,929	10,259	617.637
1998	23,731	11,316	704.891
1999	25,838	12,631	814.355
2000	28,097	14,201	945.973

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE : MAP Regional Model

TABLE 3.22. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE HIGH EMPLOYMENT IMPACT
(measured as changes from the base)
ANCHORAGE

	1983		1987		2000	
	Employment	%	Employment	%	Employment	%
Mining	11	2.3	36	1.0	119	.8
Construction	25	5.2	195	5.4	706	5.0
Trade	129	26.7	1,182	32.7	3,917	27.6
Services	125	25.8	1,084	30.0	5,567	39.2
Finance	36	7.4	304	8.4	1,486	10.5
Transportation	38	7.9	407	11.3	881	6.2
State and Local Govt.	100	20.7	262	7.2	1,105	7.8
Other*	20	4.1	146	4.0	402	3.0

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

the base case. The effect of this will be to increase the population concentration in Anchorage (see Table 3.21).

Personal Income

By 2000 Anchorage personal income is $946 million higher than in the base case. By the end of the exploration phase, personal income is .67 percent higher than in the base case. It is 4.8 percent higher by the end of the development phase.

FAIRBANKS

Employment

Tables 3.23 and 3.24 illustrate the growth of employment in Fairbanks. Fairbanks has the smallest proportionate employment impact of any of the three regions described in this section. By 2000 employment is only 4.4 percent higher than in the base case. From 1978 to 2000 employment grows at an average annual rate of 1.3 percent, compared to 1.2 percent in the base case. The impact in Fairbanks is greatest during the production phase. At the end of the exploration phase, employment is .2 percent greater than in the base case; after production, employment is 1.4 percent greater. The importance of state and local government expansion as a result of OCS development is the reason for the growth in the production phase. Since Fairbanks has only minimal connection with oil development, increases in state and local expenditures resulting from revenue increases are the major way the Fairbanks economy is impacted by OCS development. Unlike the construction of the TAPS and Alcan projects, there is no direct employment associated with Beaufort development which is located in

TABLE 3.23. PRUDHOE HIGH SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
FAIRBANKS
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979[1]	59	23	1.177
1980	127	51	3.032
1981	162	70	3.603
1982	150	85	3.874
1983	169	90	4.285
1984[2]	186		4.775
1985	166	1:;	6.115
1986	15	319	24.273
1987	398	444	31.991
1988[3]	1,739	725	48.756
1989	2,300	968	64.392
1990	2,586	1,023	70.667
1991	2,846	1,100	78.767
1992	3,102	1,230	89.136
1993	3,260	1,274	96.086
1994	3,322	1,282	99.832
1995	3,438	, 333	108.139
1996	3,540	,373	116.480
1997	3,632	,413	125.584
1998	3,701	,471	136.452
1999	3,753	,537	148.945
2000	3,764	,605	162.407

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Regional Model

TABLE 3.24. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE HIGH EMPLOYMENT IMPACT
(measured as changes from the base)
FAIRBANKS

	1983		1987		2000	
	Employment	%	Employment	%	Employment	%
Construction	5	5.5	36	8.1	136	8.5
Trade	16	17.6	103	23.1	357	22.2
Services	13	14.3	89	20.0	305	19.0
Finance	4	4.4	27	6.1	92	5.7
Transportation	7	7.7	48	10.8	180	11.2
State and Local Govt.	39	42.9	100	22.4	431	26.8
Other*	7	7.7	42	9.4	101	6.5

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

Fairbanks. The impact associated with this development is entirely through the interaction with the North Slope region and the induced regional growth. This factor minimizes the impact of Beaufort development on the Fairbanks economy.

The structural change shown in Table 3.24 reinforces the trend found in the base case. The local support sector increases in importance because of the Beaufort OCS development; over half of the impact employment by 2000 is in trade, services, and state and local government. Since these industries have been shown to be the least seasonal of Alaskan industries, the OCS impact will support the reduction in seasonality found in the base case.

Population

The population impact in Fairbanks has the effect of reducing the decline in population found in the base case after 1987. Between 1987 and 2000 population experiences a positive though low rate of growth instead of a negative rate as in the base case; population has increased by 1,424 during this period. The production phase is most important for providing this additional growth; approximately 90 percent of the additional population is achieved in this period. In both the exploration and production phases of this development, the population impact is less than 1 percent of base case population. Because of the small size of this population impact, it has only minimal effect on the population decline associated with the end of the construction of the Alcan pipeline (see Table 3.23).

Personal Income

By 2000 persona" income in Fairbanks is $162.4 million greater than in the base case. By the end of exploration, Fairbanks personal income has increased only .5 percent over the base case. By 1987, at the end of the development phase, personal income is 2.9 percent greater.

Summary and Assessment of Impacts

Relatively small impacts should result from development of the Beaufort Sea OCS according to the Prudhoe High Scenario. While this scenario has the largest impact of all those studied, compared to the recent Alaska experience, the effects on all the aggregate indicators is relatively small. The total population impact by 2000 is approximately 40,000. According to estimates of the Alaska Department of Labor, the Alaska population increased from 302,000 in 1970 to 405,000 in 1975. This is an increase of over 100,000 in only five years; the extra 40,000 population resulting from Beaufort OCS development is a twenty-year increase. The largest one year population increase as a result of Prudhoe High development is 6,000 between 1985 and 1986; this can be compared with the estimated 50,000 population increase between 1974 and 1975. Though the increase by 2000 over the base case is not minimal for any of the aggregate indicators (7 percent for population, 6.4 percent for employment, 9.2 percent for personal income, and 13 percent for state expenditures), the twenty-year period minimizes the overall impact.

Base case trends in the employment sector were, for the most part, supported by this development. Beaufort OCS development leads to increased importance of the local serving sectors. Those industries, trade, service, transportation, which increased their shares of total employment in the base case were an important part of the employment increase associated with Beaufort development. The large share of these local support sectors in the Beaufort-induced employment means that the trend toward reduced seasonality is also supported by this development. The increased importance of those industries which are the least seasonal in the economy will reduce the overall seasonality of employment. Beaufort development induces a population increase which is greater than the induced employment increase. Because of this, the overall population to employment ratio will increase; this will mean there are more people per job and a possible increase in unemployment.

The aging of the population will be slowed by Beaufort development. The major reason for this is that the increased economic opportunities will decrease the outmigration of young people. Another population trend which will be reversed by Beaufort development concerns the Native share of population which increased in the base case. Because of OCS development, the share of population which is Native will remain approximately the same as at the beginning of the period.

The revenues which flow to the state as a result of Beaufort development have two significant impacts. First, they allow an expansion of the services of state government. Real per capita state expenditures increase about 4 percent over the base case. Second, the increased state revenues delay the fiscal crisis, which occurs when expenditures exceed revenues and the permanent and general funds must be drawn down to support expenditures. Because of the expenditure response to these increased revenues, Beaufort development only delays this crisis; it does not eliminate it.

The regional concentration found in the base case continues with Beaufort OCS development. Anchorage experiences the greatest proportion of the impact in both employment and population. Major direct impacts take place in the North Slope region, since the development is located there. Almost 52 percent of the total employment impact on the North Slope is direct Beaufort OCS development. Because there are no direct ties between Fairbanks and the OCS activity and it does not possess the economic scale of Anchorage, Fairbanks is only minimally impacted by OCS development. Employment is only 1.4 percent greater than in the base case.

Prudhoe Low Scenario

The Prudhoe Low Scenario has the third greatest effect on the economy of all the scenarios. Exploration begins in 1980 and lasts until 1984, with peak exploration employment in 1981. Development begins in 1985 and lasts through 1988, with peak development employment in 1987; this is also the peak in direct employment for the entire period. Production begins in 1989 and lasts through the remainder of the forecast period.

AGGREGATE INDICATORS

Table 3.25 shows the impacts of each of the aggregate indicators of economic activity. In each case, these indicators are greater than the base

TABLE 3.25. PRUDHOE LOW SCENARIO IMPACT ON AGGREGATE INDICATORS
(measured as changes from the base)
STATE OF ALASKA
1979-2000

Year	Population	Employment	Personal Income (millions of	Total State Expenditures (millions of $)
1979	0	0	0.000	0.000
19801	260	199	8.738	0.346
1981	1,075	793	33.965	10.895
1982	1,446	985	39.164	21.613
983	1,550	962	41.066	22.694
984	1,714	991	44.254	24.101
985[2]	1,743	920	41.996	25.379
986	2,431	1,377	73.398	28.818
987	6,069	4,040	238.059	58.656
988_	7,333	4,527	263.109	69.253
19893	9,116	5,412	316.207	85.080
1990	9,493	5,167	306.012	89.275
1991	0,580	5,556	341.137	100.491
1992	1,329	5,688	360.770	109.041
1993	2,609	6,260	415.887	123.372
1994	4,071	6,952	477.543	140.114
1995	5,326	7,459	532.250	155.702
1996	15,999	7,515	555.422	165.875
1997	16,565	7,529	577 .074	175.723
1998	17,526	7,900	630.621	190.551
1999	17,482	7,493	617.180	194.793
2000	18,212	7,774	668,340	208.641

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE: MAP Statewide Model

case. Population is 18,212 greater by 2000 than in the base case. By the end of the exploration in 1984, 9.4 percent of the total population impact has been achieved. By 1988, when the development stage ends, 40 percent of the total impact has been reached; the population impact is more evenly spread than in the Prudhod High Scenario. Population growth rates differ from the base case. During the exploration phase, growth is approximately 6 percent faster than for the same period in the base. Population grows about 50 percent faster in the development phase than during the same period for the base case. The growth rate in the production phase is 9 percent higher than during the same period in the base case. By 2000 population is 3 percent greater than in the base case.

Employment experiences the same type of growth pattern, being higher than the base case by 7,774 jobs, or 2.7 percent, by the end of the period. Approximately 13 percent of the impact has been reached by the end of the exploration phase; 58 percent has been reached by the end of development. From 1979, the year before exploration begins, employment grows at an average annual rate of 1.9 percent. This is slightly greater than the growth rate in the same period in the base case. The greatest difference is in the development phase, when the growth rate is 1.7 percent compared to 1.2 percent in the base case. The growth rate in the exploration phase is 4 percent greater than for the same period in the base case, and the production phase experiences a growth rate similar to the base case.

Personal income is $668.3 million higher by 2000 because of the Prudhoe Low development. This is 3.9 percent greater than in the base case. Of this impact, 7 percent is achieved during the exploration phase and 32 percent in the development stage. Growth during the entire period averages 7.1 percent per year, which is approximately 3 percent faster than the annual average growth of 6.9 percent during the period 1978-2000 in the base case,

State expenditures are $208.6 million higher by 2000 than in the base case. Total state expenditures are $5.14 billion, compared to $4.94 billion in the base case. Over 66.8 percent of this impact occurs in the production phase of activity, compared with 12 percent in exploration and 33.2 percent in development. The annual rate of growth of state expenditures in the production phase is 4.4 percent, which is 5 percent greater than in the base case during the same period.

CAUSES OF GROWTH

The discussion in Chapter II isolated changes in exogenous employment, changes in personal income, and changes in state expenditures as the major causes of growth. Changes in these same variables are responsible for generating impacts over the base case. The most important causes of the changes discussed above are changes in exogenous construction and mining employment, which result from the Beaufort development, and changes in state expenditures. The level of Beaufort OCS employment and the associated changes in personal income are more important during the exploration and development stages prior to the rapid increase in state revenues.

At its peak in 1987 exogenous employment accounts for 25 percent of the total employment impact. By 2000 Beaufort OCS employment accounts for only 6.5 percent of total employment.

State expenditures are greater than in the base case throughout the forecast period from the beginning of exploration work. The importance of the state spending rule (see Chapter II) is that it presents another way in which OCS deve" opment affects state growth. OCS development produces revenues which · ncrease state spending, which in turn affects economic growth. The expenditure impact is much greater in the production period than in either exploration or development because the flow of oil produces both royalties and severance taxes, which provide large increases in revenues over the base period. These revenue increases cause expansion of services provided by the state and, therefore, expenditures. During production, direct Beaufort Sea employment is reduced from 887 to 502. The reduction in direct employment and the increase in revenues and expenditures after production begins make the expenditure impact a more important cause of growth.

The overall proportion of impact which results from either of these causes is hard to determine. One way to est· mate the proportion of impact caused by each factor is to examine what wou· d happen to the major variables if state expenditures remained as in the base case. This is not a description of what will happen, because state expenditures, as we have shown, will undoubtedly respond to increases in revenues. This test allows us to see in some sense the direct impact of development at Prudhoe Low.

The sensitivity analysis in Chapter IV was undertaken to show this. By 2000 private development is responsible for 49 percent of the population impact, 41 percent of the employment impact, and 45 percent of the impact on incomes. The level of petroleum revenues available from Prudhoe Low is less than in Prudhoe High; this increases the importance of private development in the impact.

FISCAL IMPACTS

Table 3.26 illustrates the changes in the state fiscal position. (Discussions in this section refer to fiscal years.) The development of the Beaufort OCS according to the Prudhoe Low Scenario improves the overall state fiscal position during the forecast period. By 2000 there is $3.7 billion more in the permanent fund than in the base case. One reason for this is that after production begins in 1989 the change in revenues resulting from Beaufort development exceeds the change in expenditure.

The change in total revenues because of OCS development is importantly affected by production. Prior to the production stage, the increase in revenues results from three sources, increases in the property taxes, increases in non-petroleum taxes, and bonuses paid to the state for leases in the state's portion of the OCS area. The first major increase in revenues results from the bonuses paid in 1980 and 1981. The interest from bonuses provides revenues to the state, even though the bonuses go into the permanent fund. During exploration, property tax revenues increase to $2.6 million because of additional . equipment and facilities required in exploration. The greatest proportion of increased revenues

TABLE 3.26. IMPACT ON THE STATE FISCAL SECTOR OF THE PRUDHOE LOW SCENARIO
(measured as changes from the base)
(in mill ions of dollars)
STATE OF ALASKA '
1979-2000

Year	Total Revenues	General Fund Balance	Permanent Fund Bal ante	Total Expenditures
1979	0.000	0.000	0.000	0.000
19801	125.243	0.000	125.000	0.346
1981	135.456	0.000	250.000	10.895
982	21.019	0.001	250.000	21.612
983	22.052	0.001	250.000	22.693
984	23.381	0.001	250.000	24.101
985[2]	24.638	0.001	250.000	25.378
986	27.736	0.001	2500000	28.818
987	41.429	-14.328	250.000	58.656
988	59.789	-20.259	250.000	69.252
989[3]	121.324	2.641	267.820	85.080
990	210.137	82.038	313.988	89.275
991	270.267	0.000	571.160	100.491
992	330.437	0,000	798.406	109.041
993	385.664	0,000	1,067.390	123.372
994	429.596	0.000	1,364.550	140.114
995	468.312	0.000	1,685.750	155.702
996	515.194	0 .000	2,044.230	165.875
997	593.367	0.000	2,471.590	175.723
998	627.918	0.000	2,919.540	190.551
999	597 .507	0.000	3,333.030	194.793
000	599.341	0.000	3,735.300	208.641

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE: MAP Statewide Model

in this period results from interest earned on the permanent fund balance; only 11.1 percent of the change in total revenues by the end of the exploration period is because of increased petroleum activity. At this time revenues are less than 1 percent greater than in the base case.

The development of the fields which occurs from 1985 to 1988 increases property tax revenues to $25.8 million. Revenues from petroleum development have increased to approximately 43 percent of the increase in total revenues by the end of development in 1988. Petroleum revenues increase, though not as dramatically as in the Prudhoe High Scenario, once production begins. Petroleum revenues directly associated with the Beaufort OCS development rise to a peak of $405.2 million in 1998; at this time petroleum revenues from the Beaufort account for 65 percent of the increase in revenues. Petroleum revenues decline throughout the remainder of the period, until they are $311.8 million in 2000.

The development of the Beaufort OCS according to the Prudhoe Low Scenario increases revenues, and it will also affect state expenditures. As new population is drawn into the state because of this development, expenditures will be increased to provide a given level of services to the increased population. The increased revenues may also lead to increases in the level of services provided, which will increase expenditures greater than the proportionate increase in population. Until the final year of the development stage, when property tax revenues increase substantially, the increase in expenditures caused by OCS development exceeds the increased revenues. The population increases, associated with the final years of development when direct Beaufort employment reaches its peak, necessitate the drawing down of the general fund to provide services. By 1988 there is $20 million less in the general fund than in the base case. After production begins, the revenue increase exceeds expenditure increases throughout the remainder of the period. Because of this, the permanent fund grows throughout the production period from 1989 to 2000.

What is the overall fiscal effect of Prudhoe Low development on the Alaska state government? First, development allows a small expansion of services provided residents. Real per capita state expenditures are $6 greater by the end of the period than in the base case. By 2000 real per capita expenditures are $1,645 per person, which is less than 1 percent more than in the base case. The extra Beaufort revenues have postponed the period when expenditures exceed revenues only slightly, until 1994, which is three years later than in the base case. The cyclical nature of petroleum revenues and increases in expenditures in response to increases in revenues lead to the eventuality of the necessity of drawing down fund balances to support these expenditure levels.

INCOME

The increase in personal income due to Beaufort OCS development can have two effects. First, higher levels of personal income will increase the demand for goods and services and lead to growth in the economy. Second, Beaufort OCS development could lead to welfare increases. To the extent personal income increases are a result of increasing wage rates, welfare will be increased. The extent to which these personal income changes will have these effects will be determined by the increased taxes paid and the increases in prices, which reduces the amount of goods and services an extra dollar of income can buy.

Table 3.27 shows the effect of taxes and prices on the increase in personal income generated by OCS development. By 2000 personal income would be $668 million higher with Beaufort OCS development following the Prudhoe Low Scenario than in the base case. Taxes take almost 25 percent of this incremental income in 2000. Prices have a much larger effect on income available to the population. To the extent prices rise because of OCS development, the effect of the added income will be reduced, and there will be a general decrease in the buying power of all income. By 2000 the change in rea" disposable personal income is only 16 percent of the change in disposable personal income, while at the end of exploration in 1983 it is 26 percent

Welfare, as measured by the increase in real per capita disposable income (DIRPA), increases during the period because of OCS development but is slightly less than in the base case by the end of the period. DIRPA has risen to as much as $45 more than in the base at the peak of exogenous employment in 1987. The influence of high wage sectors on per capita income limits it as a measure of welfare. By 2000 these industries are declining and they do not influence the measure as much. By 2000 DIRPA is about $3 less than in the base case.

TABLE 3.27. PERSONAL INCOME IMPACT OF PRUDHOE LOW DEVELOPMENT
(measured as change from the base case)
STATE OF ALASKA
1979 - 2000

Year	Per Capita Real Disposable Income	Disposable Personal Income (millions of $)	Real Disposable Personal Income (millions of
1979	0.00	0.000	0.000
1980[1]	2.43	6.765	2.003
1981	7.79	26.238	7.439
1982	7.79	30.425	8.408
1983	7.31	31.863	8.604
1984	6.62	34.351	8.983
1985[2]	4.33	32.625	8.191
1986	10.95	56.660	14.069
987	45.21	183.062	44.615
988	42.27	202.410	47.710
989[3]	43.22	243.422	55.336
990	32.22	235.496	51.716
991	30.31	262.504	55.770
992	25.69	277.172	57.028
993	26.53	319.223	63.639
1994	26.47	365.559	70.505
1995	24.44	407.113	75.942
1996	18.26	423.992	76.560
1997	11.76	440.332	76.886
1998	9.44	479.762	81.099
1999	-0.82	469.566	76.661
2000	-3.12	506.781	80.064

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Statewide Model

EMPLOYMENT

Primary employment levels associated with OCS development generate significant secondary impacts throughout the state economy. The increase in the demand for goods and services, which results because of changes in the level of personal income, lead to increases in employment in other sectors of the economy. State expenditures, which rise because of the increased revenues available from OCS development, also generate demand for goods and services and increases in employment. The growth of employment will affect the structure of employment. Table 3.28 shows the distribution of this Beaufort-induced employment impact between industrial sectors. In the base case, the general trend in the structure of employment which was observed was an increase in the proportion of total employment in the local serving sector, particularly trade and services. The extra employment which results from OCS development in the Prudhoe Low Scenario supports this base case trend. We will examine the structure of this increased employment at three point in time, the end of the forecast period, the exploration period, and the development period. The distribution of employment in 2000 supports the overall trend found in the base case. Trade, services, and finance make up 63 percent of the increased employment, mining and exogenous construction account for only 7 percent, while state and local government account for 13 percent. These percentages are fairly stable during all stages of petroleum activity. The major change is the declining proportion of employment change accounted for by direct Beaufort employment.

TABLE 3.28. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE LOW EMPLOYMENT IMPACT
(measured as changes from the base)
ALASKA

	1984		1988		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	130	13.1	892	19.7	502	6.5
Other Construction	64	6.5	277	6.1	645	8.3
Trade	200	20.2	1,036	27.9	2,104	27.0
Services	199	20.1	1,051	23.2	2,259	29.1
Finance	50	5.0	260	5.7	547	7.0
Transportation	38	3.8	187	4.1	325	4.2
State and Local Govt.	264	26.6	608	13.4	1,045	13.4
Other*	46	4.6	216	4.8	347	4.5

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Statewide Model

By the end of the production phase, the structure of employment found in the base case is reinforced by the OCS development. This should mean that the reduction in seasonality will take place as discussed in the base case. The increased proportion of employment in non-seasonal industries should reduce the overall seasonality in the economy. Direct employment in the OCS development does have a seasonal component, which may dampen the effect, but will not reduce the decrease in seasonality. Even in its peak year, over 50 percent of the increased employment is in non-seasonal industries.

In the base case a possible trend toward a reduction in unemployment was assumed because of the decrease in the ratio of population to employment. Although this does not guarantee a reduction, it indicates the possibility of a decrease. The OCS development will support this trend if the ratio of change in population to change in employment falls. This ratio reaches 2.35 in 2000, which is higher than the ratio found in 1977. This indicates the impact employment leads to greater increases in population and a possible increase in unemployment.

POPULATION

By 2000 population is 3 percent higher because of development in the Beaufort OCS. The greatest increase in population occurs in 1987, when the extra population increases 3,640 as a result of peak increases in direct OCS employment. The major factor affecting population levels is the change in migration experienced because of OCS. Migration is a response to increased employment opportunities and income. Throughout the forecast period the effect of OCS development is to reduce outmigration. In the period between 1986 and 1998, which is dominated by outmigration in the base case, increased employment opportunities associated with OCS development never cause substantial inmigration, although they do reduce the level of outmigration. In 1987 this is substantial; outmigration is reduced by approximately 3,500. The reduction in the outmigration is responsible for the increased population.

Since migration is not assumed to affect Native population, one impact of this increase is a reduction in the share of Native population in the total. By 2000 Native population is 18 percent of the total, compared to 19 percent in the base case; this is a larger share of total population than in 1977.

The structure of population will be changed in the OCS case. Migration response to changing economic opportunities most importantly affects the young. The reduction in outmigration would be assumed to dampen the aging in the population structure found in the base case. Table 3.29 shows the proportion of each age-sex classification in the total population at the end of development in 1980, 1990, and 2000. By 2000 the age structure has still undergone aging, although not quite as rapid as in the base case. By 2000 the proportion of population which is greater than forty is 2 percent less than in the base case.

TABLE 3.29. AGE-SEX STRUCTURE OF THE POPULATION
PRUDHOE LOW SCENARIO
(% of total population)

	1980		1990		2000	
	Male	Female	Male	Female	Male	Female
0 - 1	1.19	1.19	1.07	1.07	1.02	1.02
1 - 4	4.29	4.09	4.23	4.01	3.81	3.63
5 - 9	4.75	4.62	5.10	4.93	4.65	4.47
10 - 14	4.32	4.22	4.50	4.34	4.40	4.23
15 - 19	4.93	4.11	4.06	3.81	4.25	3.94
20 - 24	8.56	5.69	5.56	3.84	5.52	4.03
25 - 29	6.01	5.24	4.50	3.85	3.80	3.53
30 - 34	4.67	4.27	4.60	4.11	3.53	3.35
35 - 39	3.60	3.22	4.42	3.77	3.64	3.19
40 - 44	2.54	2.41	3.57	3.32	3.44	3.17
45 - 49	2.04	1.84	2.76	2.60	3.16	2.91
50 - 54	1.78	1.57	2.14	2.05	2.75	2.60
55 - 59	1.49	1.31	1.66	1.61	2.20	2.17
60 - 64	1.18	1.06	1.33	1.32	1.70	1.78
65 +	1.97	1.84	2.79	3.08	3.59	4.52

SOURCE : MAP Statewide Model

Regional Impacts

This section will examine the impact ofOCS development on three regions, the North Slope, Anchorage, and Fairbanks. The impacts will be measured as changes in the population, employment, and personal income growth in each region from the base case. OCS development in the Beaufort Sea impacts the state and regional economies by increasing exogenous employment, personal income, and state expenditures. Each region will be influenced differently by these growth factors because of differences in the distribution of state expenditures, interaction with other regions, the size of the local economy, and the location of exogenous employment. These mechanisms for growth and its transmission between regions will not be changed by OCS development but will distribute its effects to the regions.

NORTH SLOPE REGION

Employment

Tables 3.30 and 3.31 show the changes in North Slope employment over the base case and the industrial distribution of this change. The increase over the base case does not grow smoothly throughout the period, but experiences several peaks. By 2000 total employment is 784 greater than in the base, which is about 10 percent higher than the base. When direct employment at the OCS site peaks in the development phase in 1987, total employment is 2,379, or 34 percent, higher than the base. By the end of the exploration phase in 1983, total employment is only 3.7 percent higher than in the base.

TABLE 3.30. PRUDHOE LOW SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
NORTH SLOPE REGION
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980[1]	68	67	4.052
1981	274	260	17.301
1982	168	167	10.756
1983	279	253	18.466
1984	301	260	20.067
1985[2]	242	200	16.340
1986	755	650	56.748
1987	2.718	2,379	216.482
1988	2,293	1,941	178.271
1989[3]	1,723	1,467	135.875
1990	1,119	994	93.830
1991	1,090	1,029	102.659
1992	901	899	93.275
1993	1,085	1,095	121.654
1994	935	991	114.051
1995	931	1,015	123.186
1996	850	954	121.993
1997	779	892	120.190
1998	802	916	130.062
1999	643	761	113.901
2000	671	784	123.591

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Regional Model

TABLE 3.31. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE LOW EMPLOYMENT IMPACT
(measured as changes from the base)
NORTH SLOPE REGION

	1984		1988		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	119	46.0	856	44.1	427	54.5
Other Construction	111	42.5	881	45.4	222	28.3
Trade	2	.7	15	.8	9	1.1
Services	10	3.8	77	4.0	44	5.6
Finance	1	.4	11	.6	6	.7
Transportation	9	3.4	71	3.7	49	6.3
State and Local Govt.	7	2.7	26	1.3	22	2.8
Other*	1	.4	4	.2	5	.6

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

Employment increases on the North Slope are of two kinds. First, petroleum and construction employment located at Prudhoe Bay increases with OCS development. Because of the limited interaction this sector has with the local economy, this increase has only minimal impact on the local economy. Second, increases in employment at Prudhoe Bay lead to increases local government and state government revenue and expend. tures, which will lead to increases in the local economy. Personal incomes will also rise in the local economy because of a general expansion in wage rates, which results from OCS development. This will also increase local employment.

By removing direct petroleum and construction employment and examining changes in the remainder of the economy, we can get an indication of the effect of Beaufort development on the local economy. Elements in transportation and construction also serve the enc" ave sector. This cannot be separated, so the impact on the local economy may be overestimated. During the exploration phase, there is very l· ttle affect on the local economy. Of the 261 extra employees in 1984, 46 percent are directly associated with OCS petroleum activity. The local sector of the North Slope economy in the base case consists of 4,150 employees in 1984, so during exploration the local sector increases by 3 percent. By the end of the development phase in 988, the total impact is 1,941; of this 856 is in the enclave sector At this time in the base case, the local sector is 4,305 employees. The largest impact on the local economy occurs in this development stage with approximately 25 percent increase in the local sector. During production, direct OCS impact employment falls to 427 by 2000, which is 54 percent of the total employment impact. In the base case, the local sector is about 6,119 in 2000; impact increases the local sector employment approximately 6 percent.

By far the fastest expanding industry is construction, which ranges from 43 percent of the impact at the end of the development stage to 28 percent at the end of the period. The share of the impact in trade, services, and finance increases throughout the period from 5 percent to 7.4 which supports the trend found in the base case. After construction, transportation is the most important sector in the local economic impact, which increases its importance throughout the period as in the base case. Overall, though, the importance of exogenous employment in the employment impact impedes the base case trend of the reduction of the importance of this sector. Overall, the impact of OCS development may be to limit the trend toward reduction in seasonality of employment forecast in the base case. This results from the importance of construction in the impact employment. Seasonality may still be reduced in the local economy, if the expansion of construction is largely in the enclave sector.

Population

Table 3.30 shows the regional population impacts of Beaufort OCS development. By 2000 the North Slope Borough population has increased by 672 over the base case. This total will not have as large an impact on the local population, since over 60 percent of this increase is the extra employment in the enclave sector. The total population in the local sector is only increased by 244 above the base levels; this is a 3.2

percent increase in population. The effect on total population is more important in the other periods. The population impact by the end of the exploration phase is 183 higher than the base. By the end of development, the local population is 1,437, or 25 percent, higher than in the base.

These population increases have two effects on the North Slope Borough. First, the growth in the economy has the effect of reducing the outmigration of local residents, which has been found to be a past trend in village and rural Alaska (Alonso, 1976). Second, the increase in population at Prudhoe leads to welfare increases by increasing the revenues available to the borough, This increase in revenues can be considered an overall increase in welfare, since, assuming the enclave nature of development, there is no proportional increase in the demand for services.

Personal Income

By 2000 personal income is $123.6 million greater than in the base case as a result of development of the Beaufort OCS following the Prudhoe Low Scenario. By the end of exploration, personal income is 5.3 percent greater than in the base. Peak impact comes in 1987 during development when personal income is 49.1 percent greater than the base. This is primarily a result of the increase in the high wage construction sector.

ANCHORAGE

Employment

Anchorage has in the past served as the Alaska headquarters for petroleum and petroleum support firms. Because of this past relation, it is assumed that increased petroleum activity on the North Slope will lead to increased support activity in Anchorage. This provides a direct link between the level of OCS development and Anchorage economic growth. Additionally, Anchorage growth is affected by increases in demand for goods and services, which result from increases in the personal income of the region and increased state expenditures. Anchorage serves as a supply source for many goods and services for the rest of the state; because of this, Anchorage will experience growth if demand in the rest of the state increases.

Total employment in Anchorage is 5,908 greater than in the base case by 2000; this is a 3.5 percent increase in employment over the base. The increase over the base increases throughout the period. By the end of the exploration phase in 1984, employment in Anchorage is 492 greater than in the base, and by the end of development in 1988, employment is 2,395 higher. The importance of impact-associated employment increases throughout the period. The development of the Beaufort OCS according to the Prudhoe Low Scenario increases the growth rate from 3.1 percent in the base case to 3.3 percent per year between 1977 and 2000.

The composition of this extra employment wh· ch results from OCS development supports the structural changes found - n the base case. Between 1977 and '2000 the base case saw an expansion of the importance of the Anchorage local service sector, particularly trade and services. By examining the structural component of this extra employment, we can see this trend is supported. In all phases, exploration, production, and development, trade, services, and finance are more than 60 percent of the impact. Tables 3.32 and 3.33 show the employment trends in Anchorage. The importance of the less seasonal support sector industries in the impact employment means that Beaufort development will reinforce the trend toward reduced seasonality found in the base case.

Population

The development of the Beaufort OCS according to the Prudhoe Low Scenario increases the concentration of population in Anchorage. By 2000 population is 12,734 higher in Anchorage than in the base case; this is almost 4 percent greater than in the base case. The majority of this impact (69 percent) occurs in the production period. By the end of exploration, population is less than 1 percent higher than in the base case. Population is 1.6 percent higher than in the base case because of OCS development by the end of the development phase in 1988. The population impact in Anchorage is 70 percent of total state population in Anchorage in 2000 in the base case. The effect of this will be to increase the population concentration in Anchorage.

Personal Income

By 2000 Anchorage personal income is increased by $394.1 million over the base case. The impact grows throughout the period but experiences greater growth in the latter part of the period. At the beginning of production in 1989, only 32 percent of the total 2000 impact has been reached.

TABLE 3.32. PRUDHOE LOW SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
ANCHORAGE
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980[1]	134	63	2.221
1981	541	304	10.237
1982	777	433	14.644
1983	817	468	16.278
1984	906	492	17.861
1985[2]	933	475	17.828
1986	1,261	733	29.043
1987	3,179	2,132	89.801
1988	4,013	2,394	104.900
1989[3]	5,350	2,773	127.709
1990	5,697	2,647	126.434
1991	6,444	2,971	146.484
1992	6,997	3,077	157.406
1993	7,878	3,525	186.672
1994	8,988	3,986	219.172
1995	9,915	4,411	251.090
1996	10,477	4,647	272.863
1997	11,000	4,871	295.387
1998	11,831	5,340	334.871
1999	11,965	5,378	347.242
2000	12,734	5,908	394.105

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE: MAP Regional Model

TABLE 3.33. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE LOW EMPLOYMENT IMPACT
(measured as changes from the base)
ANCHORAGE

	1984		1988		2000	
	Employment	%	Employment	%	Employment	%
Construction	26	5.3	131	5.5	298	5.0
Trade	133	27.0	744	31.1	1661	28.1
Services	131	26.6	732	31.0	2316	39.2
Finance	37	7.5	205	8.6	620	10.5
Transportation	39	7.9	236	9.9	384	6.5
State and Local Govt.	95	19.3	215	9.0	378	6.4
Other*	31	6.3	132	5.5	251	4.2

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

FAIRBANKS

Employment

Tables 3.34 and 3.35 illustrate the growth of employment in Fairbanks. Fairbanks has the smallest proportionate employment impact of any of the three regions described in this section. By 2000 employment is only 1.7 percent higher than in the base case. From 1978 to 2000 employment grows at an average annual rate of 1.3 percent, compared to 1.2 percent in the base case. Over half of the emp" oyment impact occurs in the exploration and development phase. The size of the impact peaks in 1995, when it is 681 higher than in the base.

Changes in the structure of the economy are supported by OCS development. Local service sector of trade, services, and finance is more important in the impact than in the base, accounting for 53.5 percent in 2000. One obvious difference is the importance of state and local government, which is approximately one and a half times as important as in the base case. Since the industries which are important in the impact are the least seasonal, the impact should support the reduction in seasonality suggested by the base case.

The impact in Fairbanks is small for two reasons. First, there is no direct OCS employment assumed to locate in Fairbanks as there was with the construction of the trans-Alaska pipeline. Second, because Fairbanks is small, the support sector response is not as great as Anchorage for either growth within the region or growth in other regions.

TABLE 3.34. PRUDHOE LOW SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
FAIRBANKS
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980[1]	58	23	1.326
1981	140	72	3.958
1982	195	96	4.397
1983	157	86	4.132
1984	170	88	4.431
1985[2]	178	83	4.228
1986	148	100	6.138
1987	201	262	18.959
1988	528	358	24.842
1989[3]	1,030	488	34.262
1990	1,239	485	34.523
1991	1,385	526	38.714
1992	1,521	537	40.941
1993	1,613	576	46.136
1994	1,820	643	53.458
1995	1,931	681	58.762
1996	1,955	679	60.621
1997	1,950	669	61.939
1998	1,979	693	66.842
1999	1,887	645	64.064
2000	1,859	658	68.324

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Regional Model

TABLE 3.35. INDUSTRIAL DISTRIBUTION OF THE PRUDHOE LOW EMPLOYMENT IMPACT
(measured as changes from the base)
FAIRBANKS

	1984		1988		2000	
	Employment	%	Employment	%	Employment	%
Construction	5	5.7	40	11.1	71	10.8
Trade	16	18.2	80	22.2	152	23.1
Services	14	15.9	69	19.2	129	19.6
Finance	4	4.5	21	5.8	39	5.9
Transportation	7	8.0	37	10.3	76	11.6
State and Local Govt.	37	42.0	83	23.1	147	22.3
Other*	5	5.7	29	8.1	44	6.7

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

Population

The population impact in Fairbanks has the effect of reducing, but not eliminating, the decline in population found in the base case after 1987. Between 1987 and 2000 population declines less than 300 people, compared to 1,942 in the base case. Population increases until after 1995. The production phase is most important for providing this additional growth;
production phase is most important for providing this additional growth;
approximately 70 percent of the additional population is achieved in this period. In both the exploration and production phases of this development, the population impact is less than 1 percent of base case population. Because of the small size of this population impact, it has only minimal effect on the population decline associated with the end of the construction of the Alcan pipeline.

Personal Income

By 2000 personal income is $68.3 million greater than in the base case because of Beaufort OCS development. By the end of exploration in 1984, personal income is only .5 percent greater than in the base. It is 2.9 percent greater when production begins in 1989.

Summary and Assessment of Impacts

The Prudhoe Low Scenario is similar in most respects to the Prudhoe High Scenario. The impact of this development supports most of the trends found in the base case. The local serving sector of the economy is an important portion of the Prudhoe Low impact as it is in the Prudhoe High; this supports the base case trend of the increasing proportion of employment in these sectors. The regional concentration of both employment and population continue in Anchorage. The most important trends not supported are related to population. The aging of the population which is found in the base case is diminished somewhat by the decrease in the outmigration of the young, which results because of the increased economic opportunities associated with the induced economic growth. The other trend which is not supported is the possible decrease in unemployment found in the base case. Population induced by Beaufort (ICS development is greater than the induced employment growth, which means the ratio of population to employment will be raised. S- nce this is a measure of the probability of finding a job, it may mean - ncreased unemployment.

Prudhoe Low provides smaller revenues to the state than the Prudhoe High Scenar- o does. This has two consequences. First, it provides only minimal inc eases in the level of services over the base case. Secondly, it postpones the period when expenditures exceed revenues by only three years. The relative effects of this can be seen by comparing them to Prudhoe High, which provides almost six times the Prudhoe Low increase in state services and postpones the fiscal crunch six years.

Anchorage has the major impacts in the Prudhoe Low Scenario; by 2000 Anchorage has almost seven times the population and employment impacts in Fairbanks and the North Slope. The North Slope region experiences the greatest direct impact; at its peak, 1,003 are employed in construction and mining in connection with Beaufort development. The long-term secondary impacts of this development are small because of the enclave nature of the development; by 2000 55 percent of the North Slope impact employment is directly related to Beaufort development. The impact in Fairbanks is affected importantly by the distribution of state and local government expenditures; state and local government employment accounts for over 20 percent of the employment impact in each phase of OCS development.

For the most part, development of the Beaufort OCS following the Prudhoe Low Scenario will support most trends in the base case. Because of this and because of its relatively small overall effect on the level of employment and population (employment is 2.7 percent and population is 3 percent greater than the base), Prudhoe Small cannot be assumed to have significant impacts on the Alaska economy.

Camden-Canning Scenario

The Camden-Canning Scenario has the second largest effect on the economy of the scenarios examined. Exploration begins in 1982 and lasts until 1985, with peak exploration employment in 1983. Development begins in 1986 and lasts through 1989, with peak development employment in 1989. Production begins in 1990 and lasts through the remainder of the forecast period. Peak direct employment is reached in 1990, after production begins in the Canning field; development in the Camden field is still continuing.

AGGREGATE INDICATORS

Table 3.36 shows the impacts of each of the aggregate indicators of economic activity. Population is 26,556 greater by 2000 than in the base case. The major population impact occurs in the production phase. By

TABLE 3.36. CAMDEN-CANNING SCENARIO IMPACT ON AGGREGATE INDICATORS
(measured as changes from the base)
STATE OF ALASKA
1979 - 2000

Year	Population	Employment	Personal Income (millions of	Total State Expenditures (millions of $)
1979	0	0	0.000	0.000
1980	1	0	0.035	0.003
1981	317	242	8.308	9.152
1982[1]	1,064	794	31.300	19.394
1983	1,477	1,024	43.882	21.382
1984	1,716	1,095	48.500	22.772
1985	1,723	990	45.746	23.707
1986[2]	2,381	1,407	74.730	26.913
1987	4,421	2,833	166.434	43.761
1988	8,034	5,282	325.520	73.826
1989	9,199	5,534	335.742	83.989
1990[3]	12,618	7,584	471.367	114.741
1991	14,499	8,262	518.629	132.835
1992	16,553	9,099	585.953	153.484
993	18,058	9,497	630.508	170.082
994	20,123	10,369	719.887	193.164
995	21,966	11,039	796.590	215.292
996	22,304	10,555	781.199	222.652
997	23,733	11,049	855.945	242.859
998	24,351	10,928	872.629	254.980
999	25,198	11,066	918.199	270.875
000	26,556	11,654	1,007.830	293.758

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Statewide Model

the end of the exploration phase, 6.5 percent of the total population impact has been achieved. By 1989, before production begins, 35 percent of the total impact has been reached. During the exploration phase, the annual growth rate is approximately 8 percent higher than the base. Population grows about 49 percent faster in the development phase than during the same period for the base case. The growth rate in the production phase is 22 percent higher than during the same period in the base case. The larger relative increase during the development phase is a result of both the size and timing of development. Development occurs in the period 1986-1989 in which population growth was extremely low in the base case, averaging .8 percent per year. By 2000 population is 5 percent greater than in the base case.

Employment experiences the same type of growth pattern, being higher than the base case by 11,654 jobs, or 3.9 percent, by the end of the period. Approximately 8.5 percent of the impact has been reached by the end of the exploration phase; 47.5 percent has been reached by the end of development. From 1981, the year before exploration begins, employment grows at an average annual rate of 1.6 percent. This is 14 percent greater than the growth rate in the same period in the base case. As in population, the greatest difference between this scenario and the base is in the development phase, when the growth rate is 1.2 percent compared to .7 percent in the base case. The growth rate in the exploration phase is approximately the same for the same period in the base case, and the production phase experiences a growth rate 6 percent greater than in the base case.

Personal income is $1.01 billion higher by 2000 because of Camden-Canning development. This is 5.8 percent greater than in the base case. Of this impact, 4.5 percent is achieved during the exploration phase and 33 percent by the end of the development stage. Growth during the entire period averages 7.2 percent per year, which is approximately 4.3 percent faster than the annual average growth of 6.9 percent during the period 1978-2000 in the base case.

State expenditures are $.294 billion higher by 2000 than in the base case. Total state expenditures are $5.23 billion, compared to $4.94 billion in the base case. Over 70 percent of this impact occurs in the production phase of activity, compared with 8.1 percent in exploration and 20.5 percent in development. The annual rate of growth of state expenditures in the production phase after 1989 is 4.6 percent.

CAUSES OF GROWTH

Changes in personal income, exogenous employment, and state expenditures are responsible for generating impacts over the base case. The most important causes of the changes in the Camden-Canning Scenario are changes in exogenous construction and mining employment, which result from the Beaufort development, and changes in state expenditures. The importance of the level of Beaufort OCS employment and the associated changes in personal income are more important during the exploration and development stages. At its peak in " 990 exogenous employment accounts for 18 percent of the total employment ' mpact. By 2000, although Beaufort OCS employment is still high at 806, it accounts for only 7 percent of total employment.

State expenditures are greater than in the base case throughout the forecast period from the beginning of exploration work in 1978. OCS development produces revenues which increase state spending, which in turn affects economic growth. The importance of this effect increases throughout the period because revenue increases generate permanent increases in per capita state expenditures. The expenditure impact is much greater in the production period than in either exploration or development. The flow of oil produces both royalties and severance taxes, which provide large increases in revenues over the base period, so state expenditures are a more important source of growth after the beginning of production.

The overall proportion of impact which results from either of these causes is hard to determine. One way to estimate the proportion of impact caused by each factor is to examine what would happen to the major variables if state expenditures remained as in the base case. This is not a description of what will happen, because state expenditures, as we have shown, will undoubtedly respond to increases in revenues. This test allows us to see in some sense the direct impact of development at Camden-Canning. The sensitivity analysis in Chapter IV was undertaken to show this. By 2000 private development is responsible for 51 percent of the population impact, 44 percent of the employment impact, and 48 percent of the impact on incomes. Almost half of the Camden-Canning impact on all aggregate indicators is a result of the direct development in the Beaufort OCS.

FISCAL IMPACTS

Table 3.37 illustrates the changes in the state fiscal posture.

TABLE 3.37 IMPACT ON THE STATE FISCAL SECTOR OF THE CAMDEN-CANNING SCENARIO
(measured as changes from the base)
(in millions of dollars)
STATE OF ALASKA “
1979-2000

Year	Total Revenues	General Fund Bal ante	Permanent Fund Bal ante	Total Expenditures
1979	0.000	0.000	0.000	0.000
1980	125.002	0.000	125.000	0.003
1981	134.022	0.000	250.000	9.152
1982[1]	18.944	0.001	250.000	19.394
1983	20.750	0.001	250.000	21.382
1984	22.032	0.001	250.000	22.772
1985	22.958	0.001	250.000	23.707
1986[2]	25.839	0.002	250.000	26.913
1987	36.539	-5.125	250.000	43.761
1988	60.150	-14.864	250.000	73.826
1989	85.288	-9.026	250.000	83.989
1990[3]	211.581	56.750	287.469	114.741
1991	421.934	0.000	640.809	132.835
1992	591.347	0.000	1,087.400	153.484
1993	750.483	0.000	1,677.520	170.082
1994	897.615	0.000	2,393.060	193.164
1995	1,033.980	0.000	3,224.160	215.292
1996	1,150.47	0.000	4,164.800	222.652
1997	1,217.250	0.000	5,153.200	242.859
1998	1,268.250	0.000	6,181.170	254.980
1999	1,304.450	0.000	7,230.370	270.875
2000	1,327.770	0.000	8,281.350	293.758

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Statewide Model

(Discussions in this section refer to fiscal years.) The development of the Beaufort OCS according to the Camden-Canning Scenario improves the overall state fiscal position during the forecast period. By 2000 there is $8.3 billion more in the permanent fund than in the base case.

The change in total revenues because of OCS development is importantly affected by production. Prior to the production stage, the increase in revenues results from three sources, increases in the property taxes, increases in non-petroleum taxes, and bonuses paid to the state for leases in the state's portion of the OCS area. The first major increase in revenues results from the bonuses paid in 1980 and 1981. These revenues, according to the state's expenditure policy, go into the permanent fund. Interest earned on these balances is an important source of revenues and leads to increases in employment and population prior to the beginning of exploration in 1982. During exploration, property tax revenues increase to $1.75 million because of additional equipment and facilities required in exploration. The greatest proportion of increased revenues in this period results from interest earned on the permanent fund balance; only 7.6 percent of the change in total revenues by the end of the exploration period is because of increased petroleum activity. At this time revenues are less than 1 percent greater than in the base case.

The development of the fields which occurs from 1986 to 1989 increases petroleum revenues by $43.9 million over the end of the exploration phase. Revenues from petroleum development have increased to approximately 53.5 percent of the increase in total revenues by the end of

0

development in 1989. Petroleum revenues increase dramatical y once production begins. Petroleum revenues directly associated w th the Beaufort OCS development rise to a peak of $860.8 million in 1996; at their peak, petroleum revenues from the Beaufort account for 75 percent of the increase in revenues. As petroleum production declines, petroleum revenues fall from the peak to $741.4 million by 2000.

The deve" opment of the Beaufort OCS according to the Camden-Canning Scenario has two separate impacts on the fiscal posture of the state. It increases both revenues and expenditures. Until the final year of the development stage, when property tax revenues increase substantially, the increase in expenditures caused by OCS development exceeds the increased revenues. In 1987 and 1988, after a doubling of direct Beaufort employment, the general fund must be drawn on to maintain expenditure levels. The year before production begins (1989), the general fund is $9 million less than in the base case. After production begins, the revenue increase exceeds expenditure increases throughout the remainder of the period. This slows the rate of decrease in the general fund and allows a build-up of the permanent fund.

What is the overall fiscal effect of Camden-Canning development on the Alaska state government? First, development allows a modest expansion of services provided residents. Real per capita state expenditures are $5.60 greater by the end of the period than in the base case. The increase in services comes prior to production. Revenues associated with Beaufort production are not enough to increase the level of services.

By 2000 the level of services is greater than in the base case; real per capita expenditures are $1,644 per person, which is less than 1 percent more than in the base case. More importantly, the extra Beaufort revenues have postponed the period when expenditures exceed revenues, until 1999, which is eight years later than in the base case. The eventuality of the drawdown of the fund balances as expenditures exceed revenues has only been postponed, not eliminated by Beaufort development.

INCOME

The increase in personal income due to Beaufort OCS development can have two effects. First, higher levels of personal income associated with direct Beaufort employment will increase the demand for goods and services. Second, Beaufort OCS development could lead to welfare increases if per capita income increases.

Table 3.38 shows the effect of taxes and prices on the increase in personal income generated by OCS development. By 2000 personal income would be $1.01 billion higher with Beaufort OCS development following the Camden-Canning Scenario than in the base case. Taxes take almost 25 percent of this incremental income in 2000. Prices have a much larger effect on income available to the population. To the extent prices rise because of OCS development, the effect of the added income will be reduced, and there will be a general decrease in the buying power of all income. Prices have a greater impact later in the period. By 2000 real disposable personal income is only 16 percent of disposable personal income, while at the end of exploration in 1985 it is 25 percent.

TABLE 3.38. PERSONAL INCOME IMPACT OF CAMDEN-CANNING DEVELOPMENT
(measured as change from the base case)
STATE OF ALASKA
1979 - 2000

Year	Per Capita Real Disposable Income	Disposable Personal Income (millions of $)	Real Disposable Personal Income (millions of
1979	0.000	0.000	0.000
1980	0.002	0.031	0.008
1981	1.331	6.433	1.741
1982[1]	6.942	24.285	6.745
1983	9.177	33.996	9.239
1984	8.448	37.589	9.869
1985	6.072	35.460	8.981
1986[2]	11.884	57.644	14.363
1987	30.652	128.082	31.289
1988	60.404	249.930	59.526
1989	50.039	258.215	59.168
1990[3]	64.085	361.680	80.039
1991	57.023	398.117	84.838
1992	54.213	449.035	92.508
1993	46.891	483.199	96.207
1994	47.169	550.273	106.210
1995	43.092	608.500	113.601
1996	26.679	596.059	107.583
1997	23.332	652.355	114.013
1998	12.066	663.785	112.150
1999	4.667	697.785	113.963
2000	1.878	763.297	120.582

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE : MAP Statewide Model

Welfare, as measured by the increase in real per capita disposable incomes (DIRPA), increases because of OCS development. By 2000 DIRPA is $1 greater than in the base case. The maximum difference during the period is in 1990, when DIRPA is $64 greater. The change in this difference has a great deal to do with the composition of employment. The greatest differences in per capita incomes are achieved during the development stage in 1990, when high wage construction and petroleum employment in the Beaufort rises to 1,346. The importance of this employment to the level of per capita income can be seen by examining the changes which result from decreasing the level of this employment. Each time employment in the Beaufort is reduced, the increase in per capita income falls. The difference in per capita income declines from $64 to $1 by the end of the period; this results because of the decreasing importance of high wage mining and construction employment in the economy.

EMPLOYMENT

While the primary employment levels associated with OCS development have substantial effects, they also generate significant secondary impacts throughout the state economy. The increase in the demand for goods and services, which results because of changes in the level of personal income, lead to increases in employment in other sectors of the economy. State expenditures, which rise because of the increased revenues available from OCS development, also generate demand for goods and services and increases in employment. Table 3.39 shows the distribution of this employment between industrial sectors. In the base case, the general trend in the structure of employment which was observed was an increase in the

TABLE 3.39. INDUSTRIAL DISTRIBUTION OF CAMDEN-CANNING EMPLOYMENT IMPACT
(measured as changes from the base)
ALASKA

	1985		1989		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	121	12.2	1068	19.3	806	6.9
Other Construction	67	6.8	344	6.2	964	8.3
Trade	207	20.9	1284	23.2	3172	27.2
Services	208	21.0	1307	23.6	3410	29.3
Finance	52	5.3	323	5.8	826	7.1
Transportation	38	3.8	229	4.1	488	4.2
State and Local Govt.	251	25.4	718	12.9	1469	12.6
Other*	46	4.6	261	4.7	519	4.5

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Statewide Model

proportion of total employment in the local serving sector, particularly trade and services. The extra employment which results from OCS development in the Camden-Canning Scenario supports this base case trend. We will examine the structure of this increased employment at three points in time, the end of the forecast period, the exploration and development period. The distribution of employment in 2000 supports the overall trend found in the base case. By 2000 trade, services, and finance make up 64 percent of the increased employment, mining and exogenous construction account for only 7 percent, while state and local government account for 13 percent. These percentages are fairly stable during all stages of petroleum activity. The major change is the declining proportion of employment change accounted for by direct Beaufort employment.

By the end of the production phase, the structure of employment found in the base case is reinforced by the OCS development. This should also mean that the reduction in seasonality will take place as discussed in the base case. The increased proportion of employment in non-seasonal industries should reduce the overall seasonality in the economy. Direct employment in the OCS development does have a seasonal component, which should dampen the effect. Because of the small (7 percent) proportion of the employment impact which is direct" y affected by OCS development, this limits its impact on seasonality.

Will OCS development increase or decrease unemployment? In the base case a possible trend toward a reduction in unemployment was assumed because of the decrease in the ratio of population to employment. Although this does not guarantee a reduction, it indicates the possibility of a decrease. The ratio of population to employment in the extra employment is 2.28 in 2000; this is higher than the ratio found in 1977. This indicates the impact employment leads to greater increases in population and a possible increase in unemployment.

POPULATION

By 2000 population is 5 percent higher because of development in the Beaufort OCS. Two large increases occur because of Beaufort development; in 1988 and 1990 the impact population increases about 3,500 as a result of major increases in direct OCS employment. The major factor affecting this population change is the greater levels of migration experienced because of OCS. Throughout the period, the effect of OCS development is to reduce outmigration. Although outmigration is substantially reduced, the development of Camden-Canning never results in immigration during the 1986-1998 period dominated by outmigration in the base case. The reduction in the outmigration is responsible for the increased population.

Since migration ·s not assumed to affect Native population, one impact of this increase is a reduction in the share of Native population in the total. By 2000 Native population is 18 percent of the total, compared to 19 percent in the base case; this is greater than the Native share of total population in 1977.

The structure of population will be changed in the OCS case. Migration response to changing economic opportunities most importantly affects the young . The reduction in outmigration would be assumed to dampen the aging in the population structure found in the base case. Table 3.40 shows the proportion of each age-sex classification in the total population at the end of development in 1980, 1990, and 2000. By 2000 the age structure has still undergone aging, although not quite as rapid as in the base case. By 2000 33.6 percent of the population is older than forty which is less than in the base case.

Regional Impacts

This section will examine the impact of OCS development on three regions, the North Slope, Anchorage, and Fairbanks. The impacts will be measured as changes in the population, employment, and personal income growth in each region from the base case. OCS development in the Beaufort Sea impacts the state and regional economies by increasing exogenous employment, personal income, and state expenditures. Each region will be influenced differently by these growth factors. The location of exogenous employment, distribution of state expenditures, the size of the local economies, and the region's interaction with directly-affected regions will determine the impact in any region. These processes will not be changed by OCS development, but serve to determine the regional impacts from it.

NORTH SLOPE REGION

Employment

Tables 3.41 and 3.42 show the changes in North Slope employment over the base case and the industrial distribution of this change. The increase over the base case does not grow smoothly throughout the period, but

TABLE 3.40. AGE-SEX STRUCTURE OF THE POPULATION
CAMDEN-CANNING SCENARIO

(% of total population)

	1980		1990		2000	
	Male	Female	Male	Female	Male	Female
o - 1	1.19	1.19	1.07	1.07	1.03	1.02
1 - 4	4.29	4.09	4.22	4.00	3.83	3.65
5 - 9	4.75	4.62	5.07	4.90	4.65	4.50
10 - 14	4.33	4.22	4.49	4.33	4.39	4.22
15 - 19	4.93	4.10	4.10	3.82	4.24	3.92
20 - 24	8.55	5.68	5.69	3.93	5.56	4.05
25 - 29	6.01	5.24	4.53	3.89	3.87	3.58
30 - 34	4.67	4.27	4.59	4.09	3.59	3.39
35 - 39	3.61	3.22	4.40	3.76	3.67	3.21
40 - 44	2.54	2.41	3.55	3.29	3.43	3.16
45 - 49	2.04	1.84	2.74	2.58	3.13	2.89
50 - 54	1.78	1.57	2.13	2.04	2.71	2.57
55 - 59	1.49	1.31	1.65	1.60	2.17	2.14
60 - 64	1.19	1.06	1.32	1.31	1.68	1.75
65 +	1.97	1.84	2.77	3.07	3.54	4.46

SOURCE : MAP Statewide Model

TABLE 3.41. CAMDEN-CANNING SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
NORTH SLOPE
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980	0	0	0.000
1981[1]	1	4	0.299
1982	132	123	8.023
1983	263	241	16.978
1984	232	216	15.701
1985	247	225	17.975
1986[2]	717	632	54.787
1987	1,983	1,724	156.297
1988	3,864	3,334	314.677
1989	2,968	2,453	235.396
1990[3]	3,057	2,568	254.599
1991	2,360	2,038	208.795
1992	1,797	1,651	173.656
1993	1,454	1,444	158.428
1994	1,714	1,743	204.259
1995	1,795	1,843	228.347
1996	1,237	1,344	172.581
1997	1,506	1,600	218.810
1998	1,146	1,267	180.695
1999	1,082	1,213	182.265
2000	1,111	1,251	198.094

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Regional Model

TABLE 3.42. INDUSTRIAL DISTRIBUTION OF CAMDEN-CANNING EMPLOYMENT IMPACT
(measured as changes from the base)
NORTH SLOPE REGION

	1985		1989		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	110	48.8	1034	42.2	699	55.8
Other Construction	87	38.6	1159	47.2	345	27.5
Trade	2	.8	19	.7	14	1.1
Services	9	4.0	100	4.1	68	5.4
Finance	1	.4	14	.5	9	.7
Transportation	8	3.5	93	3.8	77	6.2
State and Local Govt.	7	3.1	30	1.2	31	2.5
Other*	1	.4	4	.2	8	.6

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

experiences several peaks. By 2000 total employment is 1,251 greater than in the base, which is about 17 percent higher than the base. When direct employment at the OCS site peaks in 1988 in the development phase, total employment is 3,335 or 55 percent higher. At the end of the exploration phase in 1985, total employment is only 3 percent higher than in the base.

An indication of the relative effects on the local economy can be achieved by separating mining and direct construction employment and examining changes in the remainder of the economy. Since some enclave sector employment is in other construction and transportation, this analysis will overestimate the growth in the local economy. During the exploration phase, there is very little affect on the local economy. Of the 225 extra employees in 1985, 49 percent are directly associated with OCS petroleum activity. The local sector of the North Slope economy in the base case consists of 4,374 employees in 1985, so during exploration the local sector increases by 3 percent. By the end of the development phase in 1989, the total impact is 2,453; of this 1,034 is in the petroleum enclave sector. At this time in the base case, the local sector is 4,371 employees. The largest impact on the local economy occurs in this development stage with approximately 32 percent increase in the local sector. During production, direct OCS impact reaches 699 in 2000, which is 56 percent of the total employment impact. In the base case, the ocal sector is about 6,119 in 2000, so that impact increases the loca sector employment approximately 9 percent.

The share of the impact in trade, services, and finance increases throughout the period, although by 2000 these industries account for only 7 percent of the employment impact. Other construction and transportation are an important sector in the local economy, which increases its importance throughout the period as in the base case, accounting for 34 percent of the total employment impact by 2000. These sectors are more directly affected by petroleum development than other sectors in the economy. Overall, though, the importance of exogenous employment in the employment impact impedes the trend of the reduction of the importance of this sector found in the base case. Because of the importance of these highly seasonal sectors found in the impact, the reduction in seasonality suggested in the base case may be limited by OCS development. This may have little effect on the local economy since the majority of the seasonal construction and mining employment is in the enclave sector.

Population

By 2000 the North Slope Borough population has increased by 1,112 over the base case. This total will not have as large an impact on the local population, since over half of this increase is the extra employment in the enclave sector. The total population in the local sector is only increased by 414 above the base levels; this is a 5.4 percent increase in population. The effect on total population is more important in the other periods. By the end of development in 1989, the local population is 2,187, or 39 percent higher than in the base. The increased population can be assumed to increase welfare in the borough for two reasons.

First, the growth in the economy has the effect of reducing the outmigration of local residents, which has been found to be a past trend in village and rural Alaska (Alonso, 1976). Second, the increase in population at Prudhoe leads to welfare increases by increasing the revenues available to the borough. The enclave nature of development means there is no proportional increase in the demand for services.

Personal Income

The peak in the personal income impact on the North Slope comes in 1988 when it is $314.7 million greater than in the base case. This occurs during the development phase and illustrates the importance of the high wage construction and mining sectors to the impact. By the end of the exploration phase in 1985, personal income is 4 percent greater than in the base. Personal income is 22 percent greater by 2000.

ANCHORAGE

Employment

Anchorage has in the past served as the Alaska headquarters for petroleum and petroleum support firms. Because of this past relation, it is assumed that increased petroleum activity on the North Slope will lead to increased support activity in Anchorage. Additionally, Anchorage growth is affected by increases in demand for goods and services, which result from increases in the personal income of the region and the remainder of the state.

Total employment in Anchorage is 8,841 greater than in the base case by 2000; this is 5.3 percent increase in employment over the base. By the end of the exploration phase in 1985, employment in Anchorage is 489, or .5 percent higher than in the base, and by the beginning of production in 1990, employment is 4,025, or 3.4 percent, higher than the base. The importance of impact-associated employment increases throughout the period. The development of the Beaufort OCS according to the Camden-Canning Scenario increases the growth rate from 3.1 percent in the base case to 3.4 percent per year between 1977 and 2000.

The composition of this extra employment which results from OCS development supports the structural changes found in the base case. Between 1977 and 2000 the base case saw an expansion of the importance of the Anchorage local service sector, particularly trade and services. By examining the structural component of this extra employment, we can see this trend is supported. In all phases, exploration, production, and development, trade, services, and finance are more than 60 percent of the impact. Tables 3.43 and 3.44 show the employment trends in Anchorage. Because of this, it can be assumed that Beaufort OCS development will support the trend toward reduced seasonality suggested in the base case.

Population

The development of the Beaufort OCS according to the Camden-Canning Scenario increases the concentration of population in Anchorage. By 2000 population is 18,690 higher in Anchorage than in the base case; this is almost 5.7 percent greater than in the base case. The majority of this

TABLE 3.43. CAMDEN-CANNING SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
ANCHORAGE
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980	0	0	0.000
1981	167	116	3.574
1982[1]	573	349	11.691
1983	790	459	16.257
1984	940	495	18.327
1985	941	489	18.509
1986[2]	1,256	725	28.876
1987	2,263	1,515	63.325
1988	4,147	2,913	126.951
1989	5,017	3,003	136.136
1990[3]	7,352	4,025	191.755
1991	8,763	4,451	219.531
1992	10,344	4,897	251.719
1993	11,468	5,231	278.781
1994	12,914	5,966	328.184
1995	14,251	6,605	375.441
1996	14,655	6,528	383.387
1997	15,802	7,207	436.953
1998	16,465	7,412	464.512
1999	17,346	7,915	512.203
2000	18,689	8,841	590.742

[1]Exploration begins
[2]Development begins
[3]Production begins

SOURCE : MAP Regional Model

TABLE 3.44. INDUSTRIAL DISTRIBUTION OF CAMDEN-CANNING EMPLOYMENT IMPACT
(measured as changes from the base)
ANCHORAGE

	1985 Employment	%	1989 Employment	%	2000 Employment	%
Mining	11	2.2	34	1.1	107	1.2
Construction	25	5.1	163	5.4	445	5.0
Trade	132	26.9	939	31.3	2499	28.3
Services	134	27.3	937	31.2	3479	39.4
Finance	38	8.0	262	8.7	930	10.5
Transportation	39	8.0	295	9.8	587	6.6
State and Local Govt.	90	18.4	255	8.5	531	6.0
Other*	20	4.1	118	3.9	263	3.0

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

impact occurs in the production period. By the end of exploration, population is less than 1 percent higher than in the base case. Population is 2 percent higher than in the base case because of OCS development by the end of the development phase in 1989. The population impact in Anchorage is 70 percent of the total impact in the state; this is greater than the 56 percent of total state population in Anchorage in 2000 in the base case. The effect of this will be to increase the population concentration in Anchorage,

Personal Income

By 2000 personal income in Anchorage is $590.7 million greater than in the base case. Approximately two-th rds of this impact occurs in the production phase. By the end of exploration, personal income is .6 percent higher than in the base case. It is 3.6 percent greater when development ends in 1989.

FAIRBANKS

Employment

Tables 3.45 and 3.46 illustrate the growth of employment in Fairbanks. Fairbanks has the smallest proportionate employment impact of any of the three regions described in this section. By 2000 employment is only 2.6 percent higher than in the base case. From 1978 to 2000 employment grows at an average annual rate of about 1.3 percent, compared to 1.2 percent in the base case. The impact in Fairbanks is greatest during the production phase. At the end of the exploration phase, employment is .2 percent greater than in the base case; after development, employment is

TABLE 3.45. CAMDEN-CANNING SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
FAIRBANKS
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980	0	0	0.001
1981	32	27	1.067
1982[1]	146	79	3.572
1983	180	94	4.674
1984	225	102	5.274
1985	197	89	4.662
1986[2]	172	104	6.429
1987	143	182	13.011
1988	198	341	25.787
1989	634	433	31.332
1990[3]	1,214	637	47.832
1991	1,664	740	55.931
1992	2,114	831	64.917
1993	2,372	872	70.387
1994	2,519	930	78.394
1995	2,444	974	85.205
1996	2,721	941	84.314
1997	2,707	955	89.605
1998	2,747	946	91.471
1999	2,713	941	94.566
2000	2,698	976	102.293

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Regional Model

TABLE 3.46. INDUSTRIAL DISTRIBUTION OF CAMDEN-CANNING EMPLOYMENT IMPACT
(measured as changes from the base)
FAIRBANKS

	1985		1989		2000	
	Employment	%	Employment	%	Employment	%
Construction	6	6.7	47	10.8	111	11.4
Trade	16	18.0	99	22.8	227	23.3
Services	14	15.7	85	19.6	193	19.8
Finance	4	4.5	25	5.8	59	6.0
Transportation	7	7.9	46	10.5	114	11.6
State and Local Govt.	35	39.3	98	22.5	207	21.2
Other*	7	7.9	34	7.8	65	6.7

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

1.3 percent greater. The importance of state and local government expansion as a result of OCS development is the reason for the growth in the production phase. Since Fairbanks has only minimal connection with oil development, increases in state and local expenditures resulting from revenue increases are the major way the Fairbanks economy is impacted by OCS development. Although the impacts are minimal, impacts during exploration and development reduce the decline caused by decreases in Alcan construction.

State and local government play a much more important role in this impact growth than in the growth in the base case. Local service sector of trade, services, and finance is still important in the impact, accounting for 49 percent of the impact by 2000. However, state and local government accounts for more than 20 percent of the impact in all three periods. Approximately 70 percent of the increased employment which results from OCS development in 2000 is in the least seasonal industries. The expansion of the local support sector and state and local government will support the general reduction in seasonality found in the base case.

The impact in Fairbanks is small for two reasons. First, there is no direct OCS employment assumed to locate in Fairbanks, as there was with the construction of the trans-Alaska pipeline. Second, because Fairbanks is small, the support sector response is not as great as Anchorage for either growth within the region or growth in other regions.

Population

The population impact in Fairbanks has the effect of reducing the decline in population found in the base case after 1987. Between 1987 and 2000 population experiences a positive though low rate of growth instead of a negative rate as in the base case; population has increased by 614 during this period. The production phase is most important for providing this additional growth; approximately 80 percent of the additional population is achieved in this period. In both the exploration and production phases of this development, the population impact is less than 1 percent of base case population. Because of the small size of this population impact, it has only minimal effect on the population decline associated with the end of the construction of the Alcan pipeline. Table 3.45 shows the population impact in each region.

Personal Income

By 2000 personal income in Fairbanks is $102.3 million greater than in the base case. Over half of this impact occurs in the production phase. After exploration and development in 1989, personal income is only 2.7 percent greater than in the base case.

Summary and Assessment of Impacts

The impacts associated with the development of the Beaufort OCS following the Camden-Canning Scenario can be assumed to be similar to those of the other scenarios, The increase in the levels of major variables falls between that of Prudhoe High and Prudhoe Low. Like these other scenarios, the absolute levels of impact are low relative to the recent Alaska historical period. The other factor which moderates the likely possibility of substantial impacts coming from development following the Camden-Canning

Scenario is the nineteen year period over which they occur. This scenario provides no major population increases in any single year; the largest increase due to OCS development is between 1987 and 1988, when the population impact increases 3,612.

The Camden-Canning scenario has the same overall impact on the trends found in the base case. OCS development generally supports the structural change found in employment in the base case. The local service sector of trade, service, finance, and transportation is a majority of the impact employment. By increasing the economic opportunities available in Alaska, Beaufort development reduces outmigration of the young and reverses the general trend toward aging of the population. Beaufort development encourages more population growth than increased employment so that the ratio of impact population to impact employment is greater by 2000 than the population to employment ratio found in the base. This could increase unemployment since the number of people seeking jobs increases by more than the number of jobs. The importance of this effect is diminished by the small proportion of total population which is associated with the impact.

Beaufort OCS development postpones the state's fiscal crisis, when expenditures exceed revenues, for eight years after it occurs in the base. After 1999 expenditures once again exceed revenues. This postponement is partially a result of the low increase in state services; real per capita expenditures increase only $5.60 over the base. This can be considered a positive fiscal effect of OCS development.

Growth which results from Beaufort OCS activity supports the increased concentration of population in Anchorage; the proportion of the impact population in Anchorage is greater than the proportion in Anchorage in the base case. The major impacts are in Anchorage, even though Anchorage has only minimal direct Beaufort employment. The North Slope has the majority of the direct employment impact; at its peak in 1990, the North Slope has 94 percent of the direct OCS employment. Because of the enclave nature of this employment, its long-term secondary impact on the North Slope is small; by 2000 approximately 56 percent of the impact employment is directly related to the OCS development. Fairbanks has only minimal impact from OCS development; the growth rate of employment increases from 1.2 percent to 1.3 percent per year.

Cape Halkett Scenario

The Cape Halkett Scenario has the smallest impact on the economy of all the scenarios. Exploration begins in 1984 and lasts until 1987, with peak exploration employment in 1986. Development begins in 1988 and lasts through 1991, with peak development employment in 1996; this is also the peak in direct employment for the entire period. Production begins in 1992 and lasts through the remainder of the forecast period.

AGGREGATE INDICATORS

Table 3.47 shows the impacts on each of the aggregate indicators of economic activity. In each case, these indicators are greater than the base case and the difference grows continually throughout the period. Population is 12,748 greater by 2000 than in the base case. By 2000

TABLE 3.47. CAPE HALKETT SCENARIO IMPACT ON AGGREGATE INDICATORS
(measured as changes from the base)
STATE OF ALASKA
1979-2000

Year	Population	Employment	Personal Income (millions of	Total State Expenditures (millions of $)
1979	0	0	0.000	0.000
1980	0	0	0.000	0.000
1981	0	0	0.000	0.000
1982	0	0	0.000	0.000
1983		0	0.000	0.000
1984[1]	14:	114	5.839	0.223
1985	430	315	17.039	1.061
1986	685	469	26.031	2.273
1987	365	165	9.402	-0.410
1988[2]	776	467	30.585	2.906
1989	2,229	1,529	103.441	15.106
1990	4,972	3,442	236.539	38.821
1991	5,198	3,172	213.148	40.515
1992[3]	6,685	3,976	260.625	54.286
1993	7,488	4,215	284.355	62.216
1994	8,370	4,531	317.062	71.392
1995	9,284	4,870	353.547	81.430
1996	10,182	5,201	391.766	91.832
1997	10,788	5,305	413.887	99.699
1998	11,627	5,621	455.902	110.648
1999	11,990	5,571	467.555	116.836
2000	12,748	5,872	513.312	128.129

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Statewide Model

population is 2.2 percent greater than in the base case. Each stage of OCS activity affects population growth differently. By the end of the exploration phase, 2.9 percent of the total population impact has been achieved. By 1991, when the development stage ends, 41 percent of the total impact has been reached so about 60 percent of the population impact occurs in the production stage.

Employment experiences the same type of growth pattern, being higher than the base case by 5,872 jobs, or 2 percent, by the end of the period. Approximately 2.8 percent of the impact has been reached by the end of the exploration phase; 54 percent has been reached by the end of development. From 1983, the year before exploration begins, employment grows at an average annual rate of 1.7 percent. This is about 6 percent greater than the growth rate in the same period in the base case. The greatest difference is in the development phase, when the growth rate is 1.2 percent compared to .9 percent in the base case. The growth rate in the exploration phase is 1 percent greater than for the same period in the base case, and the production phase experiences a growth rate 4 percent greater than in the base case.

Personal income is $.51 billion higher by 2000 because of the Cape Halkett development. This is 3 percent greater than in the base case. Of this impact, only 2 percent is achieved during the exploration phase and 42 percent by the end of the development stage. Growth during the entire period averages 7.1 percent per year, which is approximately 2.6 percent faster than the annual average growth of 6.9 percent during the period 1978-2000 in the base case.

State expenditures are $.128 billion higher by 2000 than in the base case. Total state expenditures are $5.06 billion, compared to $4.94 billion in the base case. Over 68 percent of this impact occurs in the production phase of activity. The annual rate of growth of state expenditures in the production phase is 4.5 percent, compared to 4.4 percent in the base case.

Causes of Growth

The most important cause of impacts has been shown to be two factors, increased exogenous employment associated with the development of the Beaufort OCS and the increase in state expenditures which results from this development. Both of these increase personal incomes, the demand for goods and services, and employment. State expenditures increase as a result of the policy rule (described in Chapter II), which increases expenditures in response to the increased revenues from petroleum development The rule has limited impact on the economy in the Cape Halkett Scenario because the revenues received from this development are limited. Because the Cape Halkett field is entirely on federal leases, there are no bonuses, royalties, or severance taxes paid to the state. Property taxes will increase as a result of Cape Halkett development, and royalties and severance taxes on Prudhoe Bay oil and gas will increase because of the increased flow of oil and gas through the pipelines. This should reduce the importance of state expenditures as a cause of growth.

Because of the dynamic and simultaneous nature of the economy, it is hard to determine the impact of these causes separately. The sensitivity analysis in the next chapter has been undertaken to attempt to define the proportion of impact which results from each of these factors. By using the model to investigate what would happen if state expenditures were held at their base case levels, we can get an idea of the proportion of impact which is a direct result of development. The Cape Halkett Scenario has the largest amount of impact directly related to Beaufort OCS development. This private sector development accounts for 49 percent of the employment impact, 56 percent of the population impact, and 54 percent of the impact on incomes. Even with the reduced revenues, state expenditure increases still account for close to 50 percent of the impact.

FISCAL IMPACTS

Table 3.48 illustrates the changes in the state fiscal posture. (Discussions in this section refer to fiscal years.) The development of the Beaufort OCS according to the Cape Halkett Scenario improves the overall state fiscal position during the forecast period. By 2000 there is $28.6 million more in the permanent fund than in the base case. By the end of the period, the permanent fund has been drawn down from a peak of $5.6 billion in 1993 to $1.3 billion in 2000.

Because neither royalties nor severance taxes are received from Cape Halkett, the change in total revenues because of OCS development is not greatly affected by production. Prior to the production stage, the increase in revenues results from two sources, increases in the property taxes and increases in non-petroleum taxes. There are no bonus payments from this federal sale. During exploration, property tax revenues

TABLE 3.48. IMPACT ON THE STATE FISCAL SECTOR OF THE CAPE HALKETT SCENARIO
(measured as changes from the base)
(in millions of dollars)
STATE OF ALASKA
1979-2000

Year	Total Revenues	General Fund Balance	Permanent Fund Balance	Total Expenditures
1979	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000
1984[1]	0.156	0.000	0.000	0.223
1985	0.863	0.000	0.000	1.061
1986	1.953	0.000	0.000	2.273
1987	2.256	2.826	0.000	-0.410
1988[2]	3.212	3.503	0.000	2.906
1989	9.747	-0.718	0.000	15.106
1990	25.082	-11.847	0.000	38.821
1991	40.211	0.000	-9.433	40.515
1992[3]	65.055	0.000	4.917	54.286
1993	88.480	0.000	35.261	62.216
1994	87.789	0.000	56.312	71.392
1995	88.821	0.000	68.976	81.430
1996	92.452	0.000	75.527	91.832
1997	93.758	0.000	76.015	99.699
1998	94.686	0.000	67.167	110.648
1999	95.423	0.000	53.254	116.836
2000	95.282	0.000	28.607	128.129

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Statewide Model

increase to only $.8 million because of additional equipment and facilities required in exploration. Total revenue is only .07 percent greater than in the base case in 1987; 40 percent of the change in total revenues by the end of the exploration period is a result of increased petroleum activity.

The development of the fields, which occurs from 1988 to 1991, increases property tax revenues by $24.6 million over the end of the exploration phase. Revenues from petroleum development have increased to approximately 63 percent of the increase in total revenues by the end of development in 1991. Petroleum revenues directly associated with the Beaufort OCS development rise to a peak of $67.5 million in 1993, the first year of production. The share of petroleum revenues in the Beaufort-induced total revenues is 54 percent by 2000. By 2000 petroleum revenues have fallen to $51.6 million.

The development of the Beaufort OCS according to the Cape Halkett Scenario has two separate impacts on the fiscal posture of the state. First, as discussed above, it increases revenues. Second, it will affect state expenditures. As new population is drawn into the state because of this development, expenditures will be increased to provide a given level of services to the increased population. The increased revenues may also lead to increases in the level of services provided, which will increase expenditures greater than the proportionate increase in population. In the Cape Halkett scenario the only reason for increased state epxenditure is the increased population. Real per capita expenditures are less than the base case throughout the forecast period. The difference is small ($1.70), but it means there s a reduction in the level of services pro- vialed by the state from the evels in the base case. By 1989 the general fund must be drawn down to maintain per capita expenditures,

The extra Beaufort revenues do not postpone the period when expenditures exceed revenues; in 1991, as in the base case, expenditures exceed reve- nues. By 2000 the state has about 2 percent more in the permanent fund than the base case, but the permanent fund is being drawn on to support the level of services. What is important is that this fiscal crunch came without increases in the level of services as in the other cases. Cape Halkett development led to increases in population which are similar to the population increase resulting from Prudhoe Low development, when the effect of state expenditures is removed (see Chapter IV). This in- creased population must be provided services without similar increases in revenues. To the extent the level of services is considered, Cape Halkett development may leave the state in a poorer fiscal position even though there is a larger balance in the permanent fund.

INCOME

Table 3.49 shows the effect of taxes and prices on the increase in per- sonal income generated by OCS development. By 2000 personal income would be $513.3 million higher with Beaufort OCS development following the Cape Halkett Scenario than in the base case. The effect of this on the economy depends on taxes and prices which determine the amount of goods and services this increased income will bring. Taxes take almost 25

TABLE 3.49. PERSONAL INCOME IMPACT OF CAPE HALKETT DEVELOPMENT
(measured as change from the base case)
STATE OF ALASKA
1979 - 2000

Year	Per Capita Real Disposable Income	Disposable Personal Income (millions of $)	Real Disposable Personal Income (millions of
1979	0.00	0.000	0.000
1980	0.00	0.000	0.000
1981	0.00	0.000	0.000
1982	0.00	0.000	0.000
1983	0.00	0.000	0.000
1984[1]	1.46	4.507	1.208
1985	3.86	13.128	3.396
1986	5.17	20.027	5.007
1987	0.91	7.289	1.760
1988[2]	5.73	23.511	5.658
1989	20.43	79.289	18.497
1990	43.40	180.898	40.738
1991	30.09	163.297	35.276
1992[3]	29.74	199.457	41.299
1993	26.63	217.645	43.541
1994	25.11	242.199	46.924
1995	23.28	269.918	50.571
1996	21.47	298.414	54.128
1997	16.93	315.121	55.252
1998	15.00	346.184	58.746
1999	9.07	354.848	58.168
2000	7.20	388.359	61.580

Exploration begins
[2]Development begins
[3]Production begins

SOURCE : MAP Statewide Model

percent of this incremental income. Prices have a much larger effect on income available to the population. Prices have a greater impact later in the period. By 2000 real disposable personal income is only 16 percent of disposable personal income, while at the end of exploration in 1987 it is 24 percent.

Welfare, as measured by the increase in real per capita disposable incomes (DIRPA), increases because of OCS development. By 2000 DIRPA is about $7 greater than in the base case. The maximum difference during the period is in 1990, when DIRPA is $43 greater. The change in this difference has a great deal to do with the composition of employment. The peak level of direct Cape Halkett employment also occurs in 1990. After 1990 the real per capita income in this scenario moves toward those in the base case. This results from a decline in the importance to the economy of this high wage petroleum employment sector after the beginning of production in 1990.

EMPLOYMENT

The primary employment levels and the associated increases in state spending generate significant secondary impacts throughout the state economy. The increase in the demand for goods and services, which results because of changes in the level of personal income, lead to increases in employment in other sectors of the economy. The effect on total employment has been discussed above; an equally important effect is on the growth of separate sectors. The change which results will affect the structure of employment. Table 3.50 shows the distribution of this employment between industrial sectors. In the base case, the general trend in the structure

TABLE 3.50. INDUSTRIAL DISTRIBUTION OF CAPE HALKETT EMPLOYMENT IMPACT
(measured as changes from the base)
ALASKA

	1987		1991		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	37	22.3	626	19.7	959	7.8
Other Construction	11	6.6	197	6.2	480	8.2
Trade	41	24.7	760	24.0	1617	27.5
Services	41	24.7	780	24.6	1735	29.5
Finance	10	6.0	192	6.1	420	7.2
Transportation	7	4.2	133	4.2	250	4.3
State and Local Govt.	10	6.0	336	10.6	647	11.0
Other*	9	5.4	148	4.7	264	4.5

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Statewide Model

of employment which was observed was an increase in the proportion of total employment in the local serving sector, particularly trade and services. The extra employment which results from OCS development in the Cape Halkett Scenario supports this base case trend. We will examine the structure of this increased employment at three points in time, the end of the forecast period, the exploration and the development period.

The distribution of employment in 2000 supports the overall trend found in the base case. Trade, services, and finance make up 64 percent of the increased employment, mining and exogenous construction account for only 8 percent, while state and local government account for 11 percent. These percentages are fairly stable during all stages of petroleum activity. The major change is the declining proportion of employment change accounted for by direct Beaufort emp" oyment.

By the end of the production phase, ' he structure of employment found in the base case is reinforced by the OCS development. This should mean that the reduction in seasonality will take place as discussed in the base case. The increased proportion of employment in non-seasonal industries should reduce the overall seasonality in the economy. Though direct employment in the OCS development does have a seasonal component, its small proportion of total emp" oyment should reduce its impact.

In the base case a possible trend toward a reduction in unemploymentt was suggested because of the decrease in the ratio of population to employment. Although this does not guarantee a reduction, it indicates the possibility of a decrease. The OCS development will support this trend if the ratio of change in population to change in employment falls. This ratio rises throughout the production phase until it reaches 2.17 in 2000; this is higher than the ratio found in 1977. This indicates the impact employment leads to greater increases in population and a possible increase in unemployment.

POPULATION

By 2000 population is 2.2 percent higher because of development in the Beaufort OCS. The greatest increase in population occurs in 1990, when the extra population increases 2,700 as a result of peak increases in direct OCS employment. The major factor which increases population above the base case is migration experienced because of OCS. Since migration is a response to increased employment opportunities and income, Beaufort development will affect migration positively. Throughout the period, the effect of OCS development is to reduce outmigration. In the period between 1986 and 1998, which is dominated by outmigration in the base period, increased employment opportunities associated with OCS development do not lead to immigration but the reduction in the outmigration which is responsible for the increased population.

Since migration is not assumed to affect Native population, one impact of this increase is a reduction in the share of Native population in the total. By 2000 Native population is 18 percent of the total, compared to 19 percent in the base case.

The structure of population will be changed in the OCS case. Migration response to changing economic opportunities most importantly affects the young. The reduction in outmigration would be assumed to dampen the aging in the population structure found in the base case. Table 3.51 shows the proportion of each age-sex classification in the total population at the end of development in 1980, 1990, and 2000. By 2000 the age structure has still undergone aging, although not quite as rapid as in the base case. By 2000 the proportion of population which is greater than forty is 1.5 percent less than in the base case. This age cohort, although it increases, increases at a slower rate than the total population.

Regional Impacts

This section will examine the impact of OCS development on three regions, the North Slope, Anchorage, and Fairbanks. Each region will respond differently to OCS development since they are influenced differently by these growth factors. OCS development will not change the process which determines regional growth. The location of exogenous employment, interaction between regions, distribution of state expenditures, and size of the local economy will affect the growth of any region resulting from OCS development.

TABLE 3.51. AGE-SEX STRUCTURE OF THE POPULATION
CAPE HALKETT SCENARIO

(% of total population)

	1980		1990		2000	
	Male	Female	Male	Female	Male	Female
0 - 1	1.19	1.19	1.05	1.06	1.02	1.02
1 - 4	4.29	4.09	4.21	3.99	3.81	3.62
5 - 9	4.75	4.62	5.11	4.99	4.64	4.48
10 - 14	4.33	4.22	4.52	4.36	4.39	4.23
15 - 19	4.93	4.10	4.08	3.82	4.26	3.94
20 - 24	8.55	5.68	5.56	3.84	5.57	4.05
25 - 29	6.01	5.24	4.41	3.80	3.80	3.54
30 - 34	4.67	4.27	4.56	4.07	3.50	3.33
35 - 39	3.61	3.22	4.42	3.77	3.60	3.16
40 - 44	2.54	2.41	3.58	3.33	3.41	3.15
45 - 49	2.04	1.84	2.78	2.61	3.15	2.90
50 - 54	1.78	1.57	2.16	2.07	2.75	2.60
55 - 59	1.49	1.31	1.67	1.62	2.21	2.18
60 - 64	1.19	1.06	1.34	1.33	1.72	1.79
65 +	1.97	1.84	2.81	3.11	3.62	4.56

SOURCE : MAP Statewide Model

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NORTH SLOPE REGION

Employment

Tables 3.52 and 3.53 show the changes in North Slope employment over the base case and the industrial distribution of this change. The increase over the base case does not grow smoothly throughout the period. By 2000 total employment is 709 greater than in the base, which is about 9 percent higher than the base. When direct employment at the OCS site peaks in the development phase in 1990, total employment is 2,354, or 40 percent higher. By the end of the exploration phase in 1987, total employment is less than 1 percent higher than in the base.

An important part of these employment increases on the North Slope are increases in the enclave sector; petroleum and construction employment located at Prudhoe Bay increases with OCS development. This increase has only limited impact on the local economy. Beaufort OCS development also leads to increases in the local sector; increases in local and state government revenues and personal incomes, which result because of a general expansion in wage rates, lead to growth in this sector.

The importance of growth in the local economy can be separated from total growth by examining the distribution of employment between sectors on the North Slope. The enclave sector includes portions of other construction and transportation which cannot easily be separated. By including these in the local sector, we will overestimate the growth of the local economy. During the exploration phase, there is very little affect on the local economy. Of the 58 extra employees in 1987, 50 percent are directly

TABLE 3.52. CAPE HALKETT SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
NORTH SLOPE
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980	0	0	0.000
1981	0	0	0.000
1982	0	0	0.000
1983	0	0	0.000
1984[1]	36		2.464
1985	132	1:;	9.791
1986	194	183	15.087
1987	62	58	4.992
1988[2]	372	328	30.143
1989	1,308	1,132	108.654
1990	2,748	2,353	237.982
1991	1,926	1,566	164.477
1992[3]	960	785	81.572
1993	782	713	77.696
1994	742	736	84.492
1995	718	753	91.212
1996	709	772	98.464
1997	652	734	98.832
1998	663	755	106.996
1999	586	687	102.661
2000	606	709	111.605

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE : MAP Regional Model

TABLE 3.53. INDUSTRIAL DISTRIBUTION OF CAPE HALKETT EMPLOYMENT IMPACT
(measured as changes from the base)
NORTH SLOPE REGION

	1987		1991		2000	
	Employment	%	Employment	%	Employment	%
Mining and Beaufort OCS Construction	29	50.0	606	38.7	403	56.8
Other Construction	21	36.2	788	50.3	195	27.5
Trade	1	1.7	13	.8	8	1.1
Services	3	5.2	69	4.4	38	5.4
Finance	0	0	9	.6	5	.7
Transportation	2	3.4	65	4.1	42	5.9
State and Local Govt.	2	3.4	15	.9	14	2.0
Other*	0	0	0	0	4	.6

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

associated with OCS petroleum activity. The local sector of the North Slope economy in the base case consists of 4,513 employees in 1987, so during exploration the local sector increases by less than 1 percent. By the end of the development phase in 1991, the total impact is 1,567; of this 606 is in the petroleum enclave sector. At this time in the base case, the local sector is 4,488 employees. During the development stage, local employment increases approximately 21 percent. By 2000 direct OCS impact employment stabilizes at 403, which is 57 percent of the total employment impact. In the base case, the local sector is about 6,119 in 2000, so that impact increases the local sector employment approximately 5 percent. The greatest growth in the local economy is during the development stage; this is a result of the link between other construction, transportation, and the exogenous sector.

The overall distribution of this impact is different from both the base and the other scenarios. Direct Beaufort OCS employment and local construction account for over 50 percent of the increased employment in all stages of petroleum activity. This will impede the base case trend which found trade, services, and finance employment increasing the proportion of total employment. This will have adverse effects on the overall decrease in seasonality suggested in the base case. This may not be true in the local economy, since the majority of the increase in the seasonal industries will take place in the enclave sector.

Population

By 2000 the North Slope Borough popu ation has increased by 606 over the base case. This total will not have as large an impact on the local population, since over half of this ncrease is the extra employment in the enclave sector. The total population in the local sector is only increased by 203 above the base levels; this is a 2.7 percent increase in population over the base. The effect on total popualtion is more important in the other periods. By the end of development, the local population is 1,320, or 17 percent higher than in the base.

Personal Income

The personal income impact peaks in 1990 when it is $238 million greater than in the base case. This is also the year that direct OCS employment peaks. By 2000 personal income in the North Slope is 13 percent greater than in the base case.

ANCHORAGE

Employment

Because of its past relation as the Alaska headquarters for petroleum and petroleum support firms, Anchorage is assumed to experience increased support activity as a result of North Slope development. This provides a direct link between the level of OCS development and Anchorage economic growth. Anchorage growth is also affected by increases in demand for goods and services, which result from increases in the personal income of the region and the rest of the state.

Total employment in Anchorage is 4,426 greater than in the base case by 2000; this is a 2.6 percent increase in employment over the base. The increase over the base increases throughout the period. By the end of the exploration phase in 1987, employment in Anchorage is 95 higher than in the base, and by the end of development in 1991, employment is 1,882 higher. The importance of impact-associated employment increases throughout the period. The development of the Beaufort OCS according to the Cape Halkett Scenario increases the growth rate from 3.1 percent in the base case to 3.3 percent per year between 1977 and 2000,

The composition of this extra employment which results from OCS development supports the structural changes found in the base case. Between 1977 and 2000 the base case saw an expansion of the importance of the Anchorage local service sector, particularly trade and services. By examining the structural component of this extra employment, we can see this trend is supported. In all phases, exploration, production, and development, trade, services, and finance are more than 50 percent of the impact. Tables 3.54 and 3.55 show the employment trends in Anchorage. Because the industries which are less seasonal are important in the impact, the trend toward reduced seasonality should be supported.

Population

The development of the Beaufort OCS according to the Cape Halkett Scenario increases the concentration of population in Anchorage. By 2000 population is 9,061 higher in Anchorage than in the base case; this is only 2.8 percent greater than in the base case. The majority of this impact

TABLE 3.54. CAPE HALKETT SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
ANCHORAGE
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980	0	0	0.000
1981	0	0	0.000
1982	0	0	0.000
1983[1]	0	0	0.000
1984	93	44	1.847
1985	256	133	5.595
1986	403	208	8.913
1987	230	95	4.080
1988[2]	431	269	12.107
1989	1,185	907	41.564
1990	2,661	2,054	96.942
1991	2,909	1,882	91.671
1992[3]	4,224	2,150	111.406
1993	4,811	2,334	125.180
1994	5,431	2,593	143.641
1995	6,116	2,875	164.734
1996	6,792	3,191	188.816
1997	7,293	3,411	208.156
1998	7,976	3,777	238.129
1999	8,350	3,963	257.469
2000	9,060	4,426	296.816

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Regional Model

TABLE 3.55. INDUSTRIAL DISTRIBUTION OF CAPE HALKETT EMPLOYMENT IMPACT
(measured as changes from the base)
ANCHORAGE

	1987		1991		2000	
	Employment	%	Employment	%	Employment	%
Mining	8	8.4	20	1.1	56	1.3
Construction	5	5.3	103	5.5	225	5.1
Trade	29	30.5	598	31.8	1267	28.6
Services	29	30.5	616	32.7	1743	39.4
Finance	8	8.4	171	9.1	466	10.5
Transportation	9	9.5	185	9.8	303	6.8
State and Local Govt.	3	3.2	119	6.3	234	5.3
Other*	4	4.2	70	3.7	132	3.0

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model ‘

occurs in the production period. By the end of exploration, population is less than 1 percent higher than in the state. Population is 1.1 percent higher than in the base case because of OCS development by the end of the development phase in 1991.

The population impact in Anchorage is 71 percent of the total impact in the state; this is greater than the 56 percent of total state population in Anchorage in 2000 in the base case. The effect of this will be to increase the population concentration in Anchorage.

Personal Income

By 2000 personal income in Anchorage is $296.8 million greater than in the base case because of OCS development. Over half of this impact occurs in the production phase. At the end of the development phase, OCS development has increased personal income by only .1 percent over the base.

FAIRBANKS

Employment

Tables 3.56 and 3.57 illustrate the growth of employment in Fairbanks. Fairbanks has the smallest employment impact of any of the three regions described in this section. By 2000 employment is only 1.4 percent higher than in the base case. From 1978 to 2000 employment grows at an average annual rate of 1.25 percent, compared to 1.19 percent in the base case. At the end of the exploration phase, employment is 10 greater than in the base case; after development, employment is .7 percent greater. Unlike

TABLE 3.56. CAPE HALKETT SCENARIO TOTAL ECONOMIC IMPACT
(measured as change from the base)
FAIRBANKS
1979-2000

Year	Population	Total Employment	Personal Income (millions of $)
1979	0	0	0.000
1980	0	0	0.000
1981	0	0	0.000
1982	0	0	0.000
1983	0	0	0.000
1984[1]	22	8	0.617
1985	49	22	1.627
1986	74	33	2.440
1987	41	11	0.815
1988[2]	26	26	2.353
1989	-10	86	7.719
1990	11	210	18.393
1991	257	236	19.770
1992[3]	822	372	29.745
1993	975	396	32.610
1994	1,089	422	35.958
1995	1,187	447	39.507
1996	1,266	472	43.273
1997	1,294	474	44.932
1998	1,338	495	48.842
1999	1,315	481	49.098
2000	1,319	500	53.066

[1] Exploration begins
[2] Development begins
[3] Production begins

SOURCE: MAP Regional Model

TABLE 3.57. INDUSTRIAL DISTRIBUTION OF CAPE HALKETT EMPLOYMENT IMPACT
(measured as changes from the base)
FAIRBANKS

	1987		1991		2000	
	Employment	%	Employment	%	Employment	%
Construction	2	18.2	24	10.Z	65	13.0
Trade	3	27.3	57	24.2	119	23.8
Services	2	18.2	49	20.8	101	20.2
Finance	1	9.1	15	6.4	30	6.0
Transportation	1	9*1	27	11.4	60	12.0
State and Local Govt.	1	9.1	46	19.5	91	18.2
Other*	1	9.1	18	7.6	34	6.8

*Includes Public Utilities, Communications, and Other

SOURCE: MAP Regional Model

the other scenarios, state and local government does not play as important a role in the expansion resulting from Cape Halkett development. The major sectors in the impact employment are trade and services. The majority of the impact is in the local support industries which are the least seasonal. This should support the reduction of seasonality suggested in the base case.

The impact in Fairbanks is small for two reasons. First, there is no direct OCS employment assumed to locate in Fairbanks, as there was with the construction of the trans-Alaska pipeline. Second, because Fairbanks is small, the support sector response is not as great as Anchorage for either growth within the region or growth in other regions.

Population

The population impact in Fairbanks as a result of Cape Halkett development does not eliminate the decline in population found in the base case after 1987. Between 1987 and 2000 population falls by 663; this is less than the decline of 1,942 found in the base case. The production phase is most important for providing this additional growth; approximately 80 percent of the additional population is achieved in this period. In both the exploration and production phases of this development, the population impact is less than 1 percent of base case population. Because of the small size of this population impact, it has only minimal effect on the population decline associated with the end of the construction of the Alcan pipeline.

Personal Income

By 2000 personal income in Fairbanks has increased by $53.1 million over the base case; this is 2.4 percent greater. More than half of this impact occurs in the production phase. By the end of development, Fairbanks' personal income is less than .1 percent greater than in the base case.

Summary and Assessment of Impacts

Deve opment of the Beaufort OCS according to the Cape Halkett Scenario will have minimal 'mpacts. Cape Halkett has this effect because it is one of the smallest fields of all the scenarios and there is no state share of the production from this field. These two factors rein" mize the additional employment and population results from development Cape Halkett increases population and employment by approximately 2 percent over the base by 2000. There are no major population increases in any year; instead, growth is spread out through the entire period, which also minimizes the impact.

Development according to this scenario has the same effect on the base case trends as in the other scenarios. It supports the general structural change which increases the importance of employment in the trade, service, and finance sectors and, because of this, will likely reduce seasonality. Because the increased economic opportunities reduce the outmigration of the young, Cape Halkett development slows the general aging of the population found in the base case.

The regional effects of OCS development following the Cape Halket scenario are similar to the other scenarios. The concentration of activity in

Anchorage is supported by this development; by 2000 71 percent of the population impact is in Anchorage compared to 56 percent of the base population. The North Slope also experiences the majority of the direct employment impact. As in the other cases, the long-term impacts on the local economy are small, since almost 57 percent of the impact employment is in the enclave sector. Fairbanks has very little impact, with total employment being just over 1 percent greater than in the base case. The main reason for this is the smaller state government response which is a major transmitter of growth for Fairbanks.

IV. SENSITIVITY ANALYSIS

As discussed earlier in both parts I and II, the assumptions forming the basis for both the base and development scenarios are often highly speculative and in some cases extremely arbitrary. Consequently, it is necessary to investigate the extent to which our major findings in part III are sensitive to the most speculative and arbitrary of these assumptions.

The major assumptions to which we plan to test the sensitivity of the part III analysis fall generally into four categories. First are the assumptions concerning the development plan. These assumptions encompass all aspects of the development plan affecting levels and timing of direct employment and production at each site. Such assumptions would include geology, location, resource levels, technology, and the timing of various development activities. Second are those assumptions concerning the state expenditure policy adopted throughout the forecast period. Third are those assumptions regarding the level of state petroleum revenues induced by each development. Finally, we consider the assumption implicit in the previous analysis that new direct employment in the petroleum and construction sectors generates the same migratory response as do employment changes in the endogenous and other exogenous sectors of the Alaska economy.

Sensitivity to the Choice of Development Plan

The specific development plans chosen for analysis in part III were designed to capture several elements of the uncertainty surrounding offshore development in the Beaufort Sea. However, they do not by any means capture the full range of uncertainty, and other development plans are equally plausible. Two such plans were examined--one which incorporates a much larger scale of development than described by the part III scenarios, and the other a completely pessimist" c scenario in which exploration yields no commercial discoveries.

MUL- IPLE DISCOVERY SCENARIO

One alternate development scenario for the Beaufort region is one that considers the prospect of multiple discoveries and simultaneous development of those discoveries. Because of the highly nonlinear nature of the economic relationships represented by the model as well as the importance of the fiscal policy response of state government in the total impact, the impact of a development scenario involving overlapping development of multiple discoveries is not simply the sum of the impacts of individually considered discoveries. This suggests a test of the sensitivity of the conclusions to this procedure of individual discovery analysis by contrasting the impacts of part III with a composite scenario in which all three developments (Prudhoe, Camden-Canning, and Cape Halkett) occur simultaneously.

Two such multiple discovery scenarios were examined. In the first, the "High Composite" case, three developments corresponding to the Prudhoe High discovery, the Camden-Canning discovery, and the Cape Halkett discovery, all occur. In the second, the "Low Composite" case, the Prudhoe Low discovery is developed along with the Camden-Canning and Cape Halkett discoveries.

As shown n Table 4.1, the impact of the multiple developments in the "High Composite" case is substantially greater than the sum of individually considered development impacts, while this effect is much less pronounced in the "LOW Composite" scenario.

These results suggest at least some caution in the interpretation of the results of part III and may be suggestive of an alternative methodology for future analysis. Table 4.1 illustrates that it would be erroneous to interpret the impact of a large scale development program involving discoveries at more than one of the selected sites as simply the sum of the impacts of isolated developments. Whether or not this suggests a deficiency in the methodology of part 111 depends on whether the composite scenario is more or less likely to occur than is a single isolated discovery. If the composite scenario is more likely, then the methodology of part III will understate impacts, with the degree of understatement dependent on the size of developments in the composite scenario.

"EXPLORATION ONLY" SCENARIO

On the other hand, there is a great deal of uncertainty surrounding the geology of the Beaufort Sea, and it is entirely possible that the exploration of the leased area may fail to yield any commercial discoveries whatsoever, in which case any of the scenarios considered in part III will have overstated the impact of the leasing program. Such a case, consisting of a short spurt of exploration activity only, was developed by Dames and Moore (Dames and Moore, 1978) and its impact assessed using the MAP model. The direct employment requirements of such a program

TABLE 4.1. EFFECT OF BEAUFORT SEA DEVELOPMENTON VALUES OF KEY VARIABLES IN THE YEAR 2000

Scenario	Population	Employment	Income (M m	Fund Balances (Millions of $)
Prudhoe (High)	40,157	18,697	1,587.8	7,699.0
Camden-Canning	26,556	11,654	1,007.8	8,281.4
Cape Halkett	12,748	5,872	513.3	28.6
Total	79,461	36,220	3,108.9	16,009.0
Composite "High"	93,366	44,590	3,792.6	10,207.5
Prudhoe (Low)	18,215	7,775	668.4	3,657.0
Camden-Canning	26,556	11,654	1,007.8	8,281.4
Cape Halkett	12,748	5,872	513.3	28.6
Total	57,519	25,301	2,189.5	11 ,967.0
Composite "Low"	58,548	25,973	2,231.5	10,744.1

SOURCE : MAP Statewide Model.

are presented in Table 4.2. Exploration employment peaks in 1981 at 62 persons and ends by 1987. Construction begins in 1980, peaking at an employment of 30 persons in 1982 and ceasing by 1987. Table 4.3 presents the impact of this spurt in activity on total state employment, population, income, and the state fiscal position.

The magnitude of the impacts induced by such a seemingly small and short-lived spurt in employment may appear surprising. While direct employment peaks at only 79 and then falls to zero, the long-run impact on total employment is forecast to be 730 and the long-run impact on population to be 1710. Two points should be made regarding these results. First, with such small numbers, we may be extending the model beyond what can reasonably be expected in terms of precision. Second, to the extent that such an effect does occur, it consists almost entirely of the effects due to changes in state government expenditure induced by the receipt of the initial bonus payment and by the influx of population induced by the spurt of exploration employment. The fiscal effect accounts for 89 percent of the impact on population, 95 percent of the impact on employment, and 93 percent of the impact on personal income in the year 2000. This result points dramatically to the importance of the expenditure response in the measurement of the impacts of offshore development. We turn now to consider such effects.

Sensitivity to State Expenditure Policy

In the analysis of parts II and III, it was necessary to specify an expenditure rule to capture the essential features of state fiscal policy

TABLE 4.2. DIRECT EMPLOYMENT REQUIREMENTS
-EXPLORATION ONLY SCENARIO-

Year	Petroleum Sector	Construction Sector	Total
1979	30	0	30
1980	46	13	59
1981	62	25	87
1982	49	30	79
1983	33	21	54
1984	33	21	54
1985	16	13	29
1986	16	13	29
1987	0	0	0

SOURCE : MAP Statewide Model.

TABLE 4.3. IMPACT OF "EXPLORATION ONLY" SCENARIO ON MAJOR ECONOMIC VARIABLES (1980-2000)

Year	Population	Employment	Personal Income (million $)	State Revenues (million $)	State Spending (million $)	Fund Balances (million $)
1980	282	200	8.73	125.4	.5	125.0
1985	1,243	643	27.68	19.9	20.4	250.0
1990	1,284	541	27.51	19.7	22.9	250.0
1995	1,475	618	39.35	18.9	29.2	212.4
2000	1,710	730	58.22	15.6	37.8	132.7

SOURCE: MAP Statewide Model.

over the forecast period. Inasmuch as it is actually a matter of policy choice, this rule might follow any of an infinite number of possible specifications. However, the establishment of a permanent fund into which some fraction of state petroleum revenues is to be deposited sets the framework for a fiscal policy under which current expenditures equal total revenues less permanent fund contributions. Thus, the expenditure rule assumed for the base case has the state spending available revenues less permanent fund contributions until such behavior would require decreases in real per capita expenditures, at which point the state dis-saves past accumulated balances in order to maintain such levels. However, even if we accept the general form of this expenditure rule, the rate at which eligible revenues is deposited in the fund may vary constitutionally anywhere from 25 percent to 100 percent. The choice of 60 percent in the analyses of parts II and III was arbitrary, and the sensitivity of measured impacts to this choice needs to be tested.

Two extreme cases were examined to test this sensitivity. In the first case, it was assumed that the minimum level of 25 percent was contributed to the fund. In the second case, it was assumed that the rate was set at 100 percent. Using the Prudhoe Low discovery scenario as an example, both the base case and the development case were rerun using the 25 percent and then the 100 percent rule and the measured impacts compared with those under the 60 percent rule used in the analysis of part III. Table 4.4 presents this comparison. Several points are worth noting in this comparison. First, the level of the major economic variables is extremely sensitive to the choice of an expenditure rule. For example

TABLE 4.4. IMPACTS OF OCS Development (PRUDHOE LOW SCENARIO) UNDER ALTERNATIVE EXPENDITURE RULES

	Population			Employment			Personal Income[1]			Fund Balances[1]		
Year	25% Rule	60% Rule	1 00% Rule	25% Rule	60% Rule	1 00% Rule	25% Rule	60% Rule	1 00% Rule	25% Rule	60% Rule	1 00% Rule
1980	258	260	297	198	199	227	8.742	8.738	9.602	125	125	125
1985	1,732	1,743	1,759	915	920	924	42.184	41.996	41.738	250	250	250
1990	9,890	9,493	9,494	5,439	5,167	5,160	322.430	306.012	302.395	355	396	357
1995	15,948	15,326	15,242	7,829	7,459	7,405	560,860	532.250	523.230	1,555	1,686	1,371
2000	19,165	18,215	17,973	8,285	7,775	7,625	715.410	668.420	649.860	3,435	3,657	3,797

[1] Millions of dollars

SOURCE: MAP Statewide Model.

population in the year 2000 is nearly 596,000 under the 25 percent rule, 576,000 under the 60 percent rule, and 554,000 under the 100 percent rule. Nonetheless, despite these large differences in levels of the major variables, the interesting point brought out clearly by Table 4.4 is that the measured impacts of the offshore development undergo only minor variations in response to these major fiscal policy variations. Thus, the choice of the 60 percent rule in the analysis of part III, though arbitrary, appears to be innocuous in its effects on the measured impacts of such development.

A second and more important issue arises concerning the choice of an expenditure rule, namely, the assumption implicit in the analysis of part III that the state chooses to spend new petroleum revenues induced by OCS development according to the same expenditure rule adopted in the base case. Should the state behave differently in the face of the new revenues, our measured impacts might change significantly. Even if it is implausible that the state's behavior is such as to differentiate in some way between OCS and non-OCS petroleum revenues, it may be useful to distinguish for purposes of analysis that portion of the total impact due to changes in state fiscal policy from that which is due to endogenous changes in the private economy.

In order to isolate the component of the total measured impacts attributable to state fiscal policy changes, two cases were examined for each of the development scenarios. In the first case, we assume that the state holds its absolute expenditure levels at the levels of the base case in the face of offshore development and the activity it induces. However, because OCS development activity induces both migration and price changes, such a policy would necessarily entail a cut in real per capita expenditures. Consequently, a second case is examined in which the state is assumed to hold the level of real per capita expenditures at their base case levels as offshore development proceeds. Neither of these cases is presented as plausible response patterns by the state--the state cannot adjust its behavior in the face of the development to conform to some hypothetical notion of what it would have done in the absence of the development. Rather, these cases permit us to separate, for purposes of analysis, the portion of the total impact due 'to fiscal policy changes and, of this fiscal component, the portion required simply to maintain the level of state services per capita at the levels which would have occurred without the development.

The results of these simulations are presented in Table 4.5. The third column presents the impact of each of the developments on the major economic variables in the year 2000. These are the impacts presented in part III which arise from state expenditure policy based on the "60 percent rule" discussed earlier. Using this rule, the state changes both total and real per capita expenditures in response to migration and new petroleum and non-petroleum revenues induced by the offshore development. The first column presents the total impact which would have occurred had the state maintained its absolute expenditure levels at their base case values. This can be interpreted as the purely endogenous portion of the impact resuiting from changes in the private economy. However, this results in a

TABLE 4.5. MEASUREMENT OF COMPONENT OF TOTAL IMPACTS DUE TO CHANGES IN STATE GOVERNMENT EXPENDITURE

		Impact in the Year 2000		
Scenario	Variable	Holding Total Expenditures at Base Levels	Holding Real Per Capita Expenditures at Base Levels	Using 60% Expenditure Rule
Prudhoe (High)	Population	15,341	28,350	40,157
	Employment	5,915	12,621	18,697
	Income[1]	566.1	1,103.0	1,587.8
	Fund Balances[1]	14,600.3	11,408.2	7,698.9
Prudhoe (Low)	Population	8,985	16,680	18,215
	Employment	3,189	7,087	7,775
	Income[1]	304.7	614.9	668.4
	Fund Balances[1]	6,280.5	4,399.8	3,657.4
Camden-Canning	Population	13,674	25,034	26,556
	Employment	5,096	10,983	11,654
	Income[1]	485.6	955.2	1,007.8
	Fund Balances[1]	11,523.1	8,861.2	8,281.4
Halkett	Population	7,186	12,857	12,748
	Employment	2,889	5,926	5,872
	Income[1]	276.4	517.9	513.3
	Fund Balances[1]	1,035.2	-87.5	28.6

[1] Millions of dollars

SOURCE : MAP Statewide Model .

decline in real per capita state spending from the base levels. Should the state maintain real per capita expenditures at the base case levels, the impacts of column (2) would result.

In the Prudhoe High case, the state would accumulate new balances totaling $14.6 billion by 2000 if expenditures were held at their absolute base case levels, and the impacts of the development would be limited to slightly over one-third of the total impact which occurs as a consequence of the 60 percent rule. Under that rule, the state spends nearly $7 billion of these induced revenues, about $3 billion of which is required to maintain the level of per capita services which would have occurred without the development, and the remaining $4 billion to increase the level of real per capita expenditures.

In the Prudhoe Low case, the state spends $2.6 billion of new revenues totaling $6.3 billion, about $1.9 billion of which is required to maintain base levels of real per capita expenditures. This spending pattern results in a total impact on the major economic variables which is about twice as large as the purely endogenous impacts.

In the Camden-Canning case, the state spends $3.2 billion of induced revenues, of which $2.6 billion is required to maintain base levels of real per capita expenditures, resulting in a total impact of about twice the size of the purely endogenous effects.

In the Cape Halkett scenario, the state spends all but $29 million of its induced revenues of $1 billion but is still unable to maintain real per capita expenditures at their base case levels. This expenditure pattern induces impacts of less than twice the purely endogenous effect, but maintaining real per capita spending at the base case levels would require even additional spending by the state. This insufficiency of revenues to finance base case levels of real per capita expenditures contrasts with the other three cases in which real per capita expenditures rise under the 60 percent rule and stems from the fact that the Cape Halkett development occurs on exclusively federal property, thus failing to generate the royalties and production taxes characteristic of the other developments.

These results point to a central feature of the impacts of offshore development in Alaska. Because of the dominant role of the state and local government sector in the state, and the magnitude of the fiscal changes likely to be induced by offshore development, induced changes in state fiscal behavior overwhelm the purely endogenous changes induced by direct employment requirements. Furthermore, because of the responsiveness of state expenditures to induced revenue changes, an examination of the sensitivity of the part III conclusions to our revenue assumptions is in order. We turn now to such an examination.

Sensitivity to Revenue Assumptions

For reasons discussed above, the fiscal response of state government to the changes induced by offshore development will dominate the total economic impact of such projects. Because this response is in part determined by exogenous petroleum revenues, the sensitivity of our major impact measures to these revenue estimates needs to be examined.

Errors in the estimates of petroleum revenues presented in part 111 might stem from any of a variety of sources, such as:

- variations in production rates from assumed levels;
- variations in wellhead value due to misestimation of market prices or transport costs;
- variations in production tax rates or royalty rates due to tax law changes or the introduction of royalty bidding; or
- variations in the distribution of federal/state resource ownership from that assumed in part 111,

Consequently, the estimates of part III must be considered highly speculative and subject to wide margins for error.

Because of this, each of the development scenarios was rerun using petroleum revenue estimates 50 percent higher and 50 percent lower than those assumed in part III. While these are extremely wide margins for error, they are not unrealistic in light of the uncertainty surrounding the revenue estimates. For example, should the state of Alaska win its jurisdictional dispute with the federal government over the determination of the three-mile boundary, its share of the Prudhoe High or the Prudhoe Low discovery would increase by over 50 percent from that assumed in part III. Table 4.6 presents the results of these alternate simulations for each of the four discoveries.

The table suggests that the measured impacts of the Prudhoe Low discovery and the Cape Halkett discovery on population, employment, and income are relatively insensitive to these wide variations in exogenous revenues. The Camden-Canning scenario is particularly sensitive to underestimation, but because of the small area of disputed ownership within the Camden-Canning discovery area (a state victory in the jurisdictional dispute would increase the state share of the discovery by only 8 percent), it is not subject to as much risk of underestimation as the Prudhoe scenarios, for example.

On the other hand, the Prudhoe High scenario impacts are extremely sensitive to the exogenous revenue estimates. Should exogenous revenues be 50 percent larger than estimated in part III, the impact of such development on the major economic variables would be over 50 percent larger than estimated in part III. Should such revenues be 50 percent lower than estimated, impacts would be some 33 percent lower than estimated. In summary, one would have to conclude that given this extreme sensitivity, combined with the fact that the state ownership of the Prudhoe High discovery could easily increase by 50 percent or more with a favorable court decision, the measured impacts of the Prudhoe High discovery reported in part III must be regarded as extremely speculative.

TABLE 4.6. SENSITIVITY OF MEASURED IMPACTS TO ERRORS IN PETROLEUM REVENUE ESTIMATES

Scenario	Variable	With 50% Overestimate of Petroleum Revenues	Measured Impact in Part III	With 50% Underestimate of Petroleum Revenues
Prudhoe (High)	Population	27,597	40,157	61,136
	Employment	12,235	18,697	29,554
	Income	1,071	1,588	2,464
	Fund Balances	4,754	7,699	8,024
Prudhoe (Low)	Population	17,144	18,215	19,277
	Employment	7,280	7,775	8,268
	Income	629	668	707
	Fund Balances	1,261	3,657	6,054
Camden-Canning	Population	25,564	26,556	35,389
	Employment	11,192	11,654	16,441
	Income	971	1,008	1,391
	Fund Balances	3,300	8,281	11,383
Hal ket	Population	12,723	12,748	12,768
	Employment	5,860	5,872	5,882
	Income	512	513	514
	Fund Balances	-353	29	410

SOURCE : MAP Statewide Model

Sensitivity to Migration Response

The final test to which the conclusions of part III were put related to the assumption implicit in the analysis of part III that changes in exogenous construction and petroleum sector employment in response to offshore development induce the same patterns of migration from the Lower 48 as do changes in employment in any other sector. This has been the subject of some criticism inasmuch as it is alleged that the new employment generated by offshore development is highly specialized, and known to be so, so that it does not induce the patterns experienced in the past when new employment was felt to be open to any migrant who appeared Thus, it is argued that the effects of such employment changes are like" y to have minimal effects on inducing migration.

Consequently, using the Prudhoe Low case as an example, a simulation was performed in which it was assumed that changes in petroleum and exogenous construction sector employment have <u>no effect</u> whatsoever on net migration throughout the forecast period. This is an <u>extreme</u> assumption which undoubtedly overstates any reasonable case which could be made for a diminished migratory response. However, even with this extreme assumption, the total population impact of the development by 2000 is less than 3.2 percent different from the estimated impact assuming a normal response, as shown in Table 4.7.

While such a difference matters in the initial development years, the effect of the direct employment is quickly dominated by the effect of the induced employment in determining net migration, so that the effect of

TABLE 4.7. IMPACT OF PRUDHOE LOW DEVELOPMENT ON STATE POPULATION UNDER ALTERNATIVE MIGRATORY RESPONSES TO DIRECT EMPLOYMENT IN CONSTRUCTION AND PETROLEUM

Year	Full Migratory Response	No Migratory Response	% Difference
1980	260	161	-38.1
1985	1,743	1,618	- 7.2
1990	9,493	8,204	-13.6
1995	15,326	14,066	- 8.2
2000	18,215	17,627	- 3.2

SOURCE: MAP Statewide Model.

varying this assumption, even if information were available on how to do so, would be insignificant in its effect on our final conclusions as to measured impacts.

V. SUMMARY AND CONCLUSIONS

In this report, we have set out to assess the major impacts that an off-shore oil and gas development in the Beaufort Sea would have on the process of Alaska economic growth and the distribution of these impacts among the various regions of the state.

For all of the scenarios examined, the qualitative nature of the influence of the development on the growth process is similar. The development program generates a wave of direct employment activity in the construction and petroleum sectors, building to a peak several years after the start of development, then declining to a stable long-term level as production commences. These activities generate streams of new private incomes and public revenues, which induce a set of impacts which may be separated conceptually into two parts. First, the expenditure of wages and salaries earned in direct employment generates further income and employment in the endogenous sectors of the economy through the increased demand for the output of these sectors. Second, the expenditure of new public revenues by state and local governments generates a first round of employment in both government and the construction industry (through capital expenditures), which in turn induces multiplier effects throughout the endogenous sectors. Of the two components, the analysis of part IV demonstrates that the latter was generally the dominant effect. The increased incomes generated by both effects have their greatest impacts on the growth of the support sectors--trade, services, and finance, which increase in share of total employment as a consequence of the development. Changes in both income and employment, however, serve to induce increased net migration into the state, so that despite short-term gains in per capita income at the peak of development, the long-run impact of such development is to increase the level of state population with per capita incomes virtually unchanged.

With regard to the regional distribution of developmental impacts, we find that virtually all of the direct employment activity associated with such development will occur within the North Slope Borough. However, because of the "enclave" type nature of these direct activities, combined with the dominance of Anchorage as a statewide distribution and support center, very little of the induced employment impacts of development occur in the North Slope Borough, but rather are overwhelmingly concentrated in Anchorage. The fiscal effect described above serves to reinforce this dominance of Anchorage in absorbing the bulk of any impacts, as well as to induce impacts in the Fairbanks region.

Quantitatively, the major long-run impacts of each of the scenarios examined are summarized in Table 5.1. As seen in the table, the single most important determinant of the relative importance of the impacts of each scenario was discovery size, with the 1.9 billion barrel discovery of the Prudhoe High scenario dominating the scenarios with long-run impact of over 40,000 on state population, over three times the impact associated with the .8 billion barrel discovery at Cape Halkett. However, the effect of resource ownership is also readily apparent from the table. For example, the peak of direct employment requirements for the Cape Halkett

TABLE 5.1. SUMMARY OF LONG RUN IMPACTS OF ALTERNATIVE DEVELOPMENT SCENARIOS

Scenario	Direct Employment		Discovery Size		% State Owned	Impact in the Year 2000			
	Peak	2000	Oil (BB)	Gas (TCF)		Population	Employment	Income (millions of $)	Fund Balances (millions of $)
Prudhoe High	1,759	940	1.9	4.75	61	40,156	18,696	1,587.8	7,699.0
Prudhoe Low	1,027	502	0.8	1.60	64	18,212	7,774	668.3	735.3
Camden-Canning	1,346	806	1.3	3.25	87	26,556	11,654	1,007.8	8,281.4
Cape Hal kett	897	459	0.8	0	0	12,748	5,872	513.3	28.6

SOURCE: MAP Statewide Model

scenario is about 12 percent lower than those associated with the Prudhoe Low scenario, while the impacts associated with the Halkett scenario are 30 percent lower than those of the Prudhoe Low case. This reflects the dampened fiscal effect attributable to federal ownership of the Halkett properties. With respect to the regional distribution of impacts, Table 5.2 summarizes the effects of each of the four scenarios, clearly pointing out the dominance of Anchorage in absorbing nearly 60 percent of the income increases, over 75 percent of the employment impacts, and about 70 percent of the population impacts of the development program.

As mentioned repeatedly throughout this report, many of the central features of Beaufort Sea development remain unknown, and, consequently, many of the assumptions incorporated into the scenarios must be regarded as highly speculative. As the analysis of part IV illustrated, many of the measured impacts presented here are insensitive to the more speculative and arbitrary of our assumptions. However, other conclusions, such as the impacts of the Prudhoe High case, are highly sensitive to very speculative assumptions, such as the outcome of the federal/state jurisdictional dispute, and must be regarded as tentative until more information becomes available. In addition to the uncertainties brought out in the analysis, several more basic variations could alter our analysis in fundamental ways. First, projections regarding energy supplies over so long a period as the twenty-three year forecast presented here risk neglecting major technological changes, the discovery of substitute energy forms, or alternative crude supply sources which would completely invalidate our implicit assumption of continued demand for North Slope crude through the year 2000.

TABLE 5.2. SUMMARY OF DISTRIBUTION OF IMPACTS BY REGION

		Percent of Total Year 2000 Impact			
Variable	Region	Prudhoe High	Prudhoe Low	Camden-Canning	Cape Halkett
Population	Anchorage	70.0	69.9	70.4	71.1
	Fairbanks	9.4	10.2	10.2	10.4
	North Slope	3.6	3.7	4.2	4.8
Employment	Anchorage	76.0	76.0	75.9	75.4
	Fairbanks	8.6	8.5	8.4	8.5
	North Slope	8.4	10.1	10.7	12.1
Income	Anchorage	59.6	59.0	58.6	57.9
	Fairbanks	10.2	10.2	10.1	10.3
	North Slope	15.7	18.6	19.6	21.8

SOURCE: MAP Regional Model

Second, it is possible, though unlikely, that major new discoveries of oil or gas in the Prudhoe area, in the National Petroleum Reserve, or in the Arctic Wildlife Range would fill existing TAPS capacity prior to the on-set of production from the Beaufort Sea, thus either requiring construction of new pipelines, utilization of alternative transport modes, or the cutback of production from earlier discoveries to ration existing capacity. Third, new legislation by Congress or the Alaska Legislature could significantly alter the institutional arrangements surrounding OCS development in ways which would substantially alter the impacts of such developments. Finally, the introduction of changes in the regional structure of the Alaska economy, such as would be introduced by a capital move, would alter the regional distribution of impacts, most likely intensifying even further the proportion of impacts occurring in Anchorage and the Southcentral region.

However, within the existing structure of technology, market demand for oil, regional economies, and institutional arrangements, the analysis presented above presents at least a plausible range of impacts to be expected from Beaufort Sea development, as well as a methodology for the incorporation of additional information into the assessment of these impacts as such information becomes available.

APPENDIX A

METHODOLOGY AND ASSUMPTIONS
OF MAP MODEL

APPENDIX A: METHODOLOGY AND ASSUMPTIONS OF MAP MODEL

The MAP Statewide Model

The basic model to be utilized in the analysis of the Beaufort Sea development scenarios is the statewide econometric model of the Alaska economy developed by the Man-in-the-Arctic Program (MAP) presently being conducted jointly by the Institute of Social and Economic Research of the University of Alaska and the Joint Center for Urban Studies of MIT and Harvard University.[1] The model consists of three major components--an economic model of state incomes and employment, a demographic model of state population, and a fiscal model of state and local government revenues and expenditures and federal tax payments. We now proceed to a description of each component and the linkages between them.

THE ECONOMIC MODEL

The economic component of the MAP model is designed to produce projections of Alaska prices, incomes, output, and employment. In the model, the state economy is broken down into fourteen sectors, as shown in Table A-1. Of these, six sectors--agriculture, forestry, fisheries, federal government, manufacturing, and mining (including petroleum)--are wholly exogenous. That is, these sectors are affected primarily by influences

[1]See David T. Kresge, "Alaska's Growth to 1990," Alaska Review of Business and Economic Conditions, January 1976; Danie A. Seiver, "Alaskan Economic Growth: A Regional Model with Induced Migrat on," Anchorage, 1975; Scott Goldsmith; "Fiscal Options and the Growth of the Alaskan Economy," Anchorage, 1977; and David T. Kresge, et al Issues in Alaska Development, forthcoming 1978.

TABLE Al. INDUSTRIAL CLASSIFICATIONS, MAP STATEWIDE MODEL

Exogenous Industries

1. Agriculture
2. Forestry
3. Fisheries
4. Manufacturing
5. Mining (Petroleum)
6. Federal Government

Endogenous Industries

7. Trade
8. Services
9. Finance
10. Transportation
11. Communications
12. Public Utilities

Mixed Industries

13. Construction
14. State & Local Government

external to the Alaska economy so that output and/or employment in each of these sectors must be estimated outside of the model and input exogenously for a model run. A development "scenario" consists largely of these exogenous sector employment and output assumptions. Six other sectors--trade, finance, services, transportation, communications, and public utilities--are treated as wholly endogenous inasmuch as production and employment in those sectors is aimed solely at satisfying local demands. Other sectors, namely construction and state and local government, have both exogenous and endogenous components. Construction sector activity consists of both exogenous employment in such activities as pipeline and petroleum sector facility construction as well as endogenous employment involved in the construction of homes, offices, roads, and other facilities designed to serve local demands. State government grows largely in response to either revenue changes or population growth induced both by the growth of endogenous state incomes (personal and corporate income taxes, licenses, and fees), as well as the exogenous growth of resource related revenues (bonuses, royalties, etc.).

Figure A-1 presents schematically the structure of the state economic model. The model consists of a series of simultaneous equations, calibrated for the historical period 1961 to 1974. The variables in the economic model are estimated roughly as follows: An Alaska price index is estimated as a function of both the U.S. Consumer Price Index and the growth in Alaska employment. Industrial employment is estimated outside of the model for the exogenous sectors, and output for such sectors is determined by historical relationships with employment in such sectors. For the endogenous component of the construction sector and the other endogenous sectors (except for state and local government, described below), output is estimated as a function of state real disposable personal income. Sectoral employment is then estimated from historical relationships between sectoral output and employment in the state. Sectoral wage rates are computed as a function of real average weekly earnings in the U.S., as well as the Alaska price index, and in the case of sectors particularly sensitive to exogenous "booms," such as transportation, petroleum, and construction, by the proportion of total employment engaged in petroleum and exogenous construction. Alaska wages and salaries are computed as the sum of the product of sectoral employment and wage rates, and personal income is estimated as a function of wages

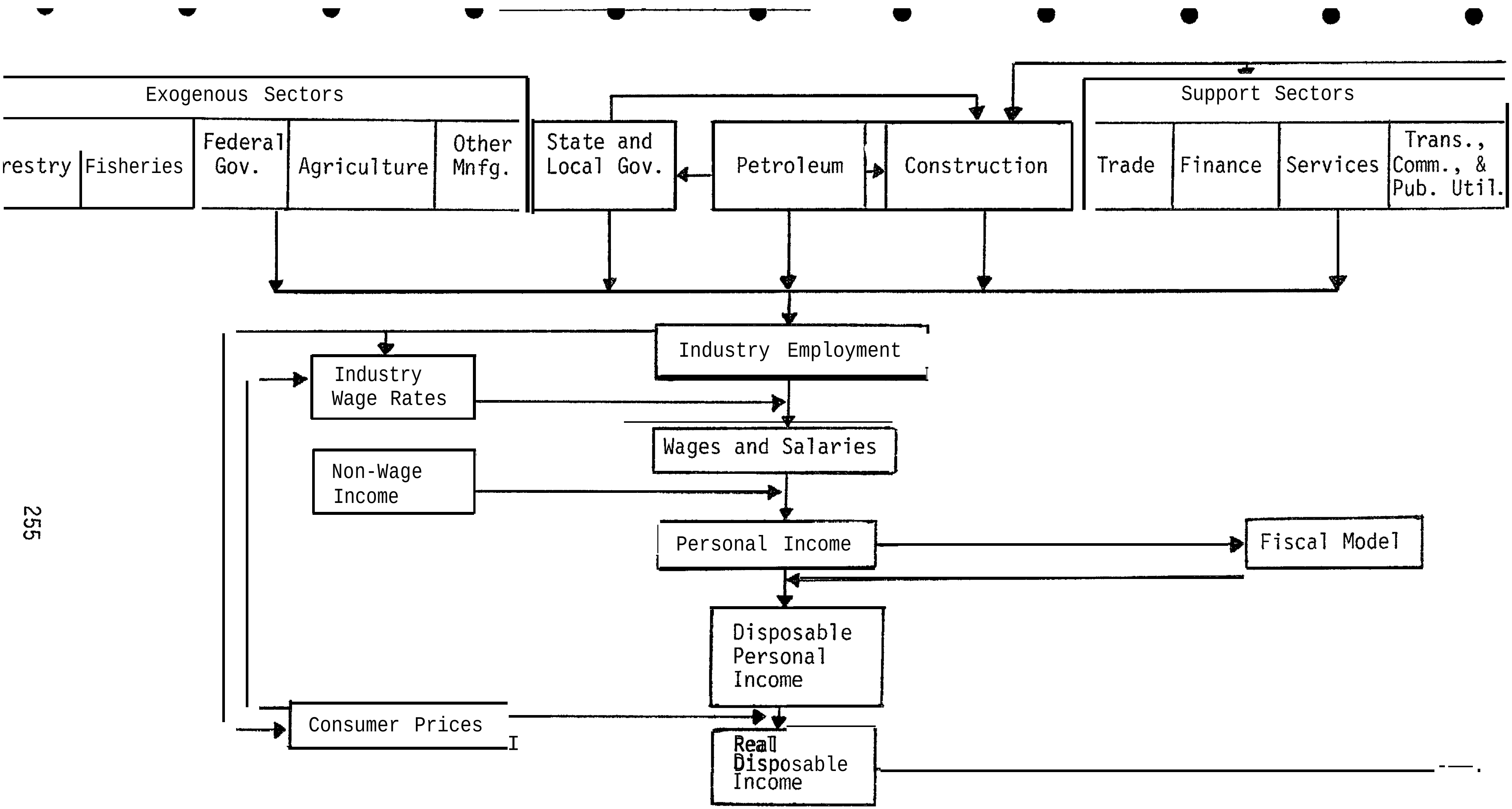

Figure A.1 STRUCTURE OF THE MAP ECONOMIC MODEL

Source: Kresge, D.T., "Alaska's Growth to 1990," Alaska Review of Business and Economic Conditions, January, 1976.

and salaries. Personal tax payments (calculated from the fiscal model described below) are subtracted from personal income to arrive at disposable personal income. Real disposable personal income, by producing local demands, then acts to determine endogenous industrial output. Because of this interrelationship between incomes and output, both are simultaneously determined in each time period.

THE DEMOGRAPHIC MODEL

A second component of the MAP statewide model forecasts Alaskan population growth. The structure of the demographic model is shown in Figure A-2. Population growth is determined by two factors--the rate of natural increase (excess of births over deaths) and the rate of net migration to or from Alaska. Net migration to or from the state is determined by two factors--changes in state employment and the ratio of Alaska non-Native real per capita income to average U.S. real per capita income. The age-sex distribution of the population, as altered by net migration, combined with fertility and mortality rates, then determines the rate of natural increase. The output of the state population model is an annual forecast of total population. The model also provides the age-sex and Native-non-Native distributions for the annual forecast of population.

THE FISCAL MODEL

Because of the central role of the federal, state, and local government sectors in the determination of the overall level of economic activity, and consequently state migration, in Alaska, the third component of the MAP statewide model is devoted to an explicit modeling of the behavior

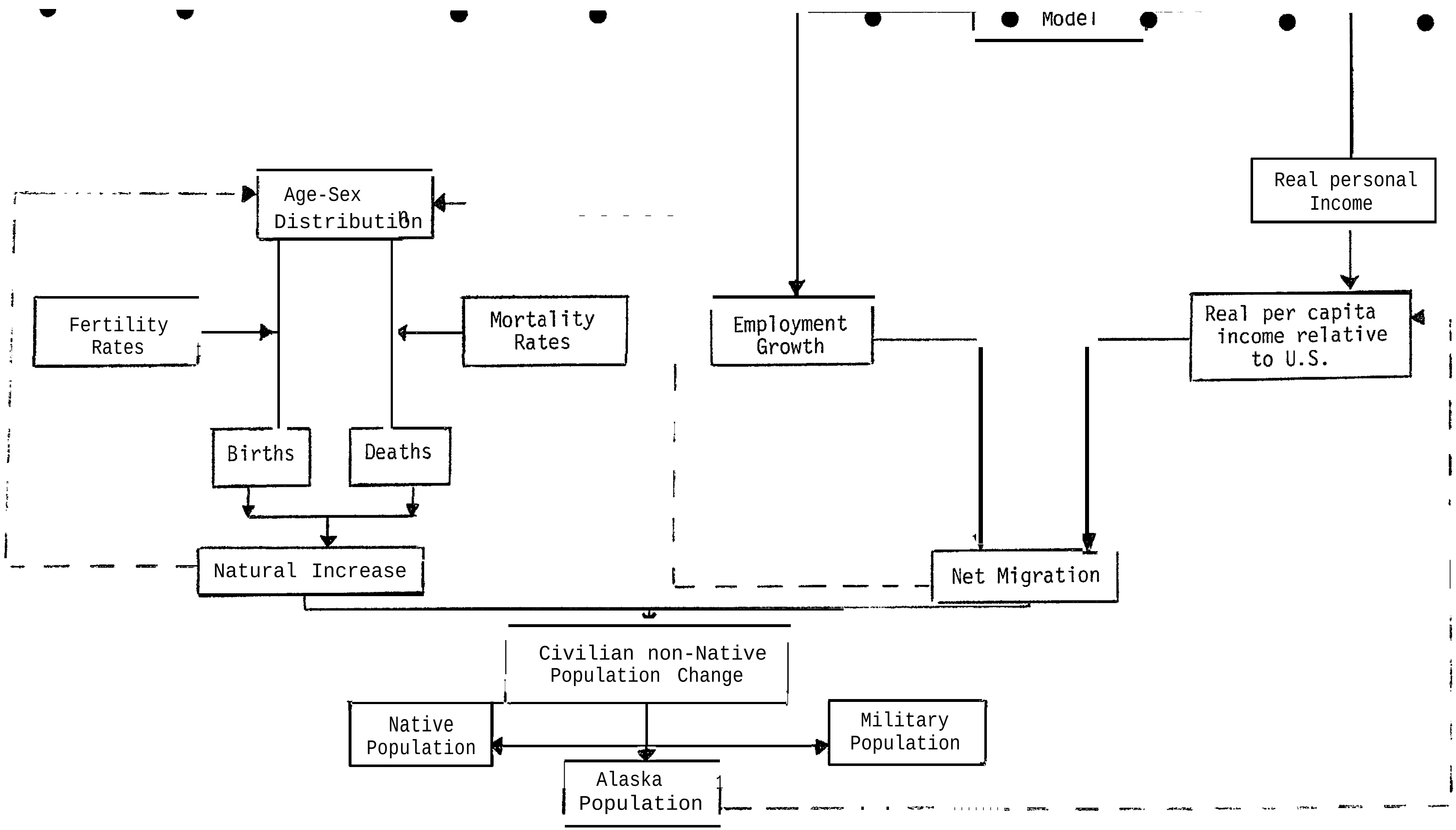

Figure A.2 STRUCTURE OF THE MAP ECONOMIC MODEL

Source: Kresge, D.T., "Alaska's Growth to 1990," Alaska Review of Business and Economic Conditions, January, 1976.

of the government sectors in Alaska. The functions of the fiscal model within the larger MAP model are threefold: first, to calculate personal tax payments in order to derive disposable personal income from personal income; second, to provide a framework for the analysis of alternative choices for explicitly modeled policy variables; and finally, to provide the basis for estimates of state and local government employment which result from such policy choices.

Figure A-3 represents schematically the structure of the MAP fiscal model. Estimation of federal, state, and local tax and non-tax payments is accomplished by a set of equations which estimate the federal tax base in Alaska from personal income, then estimate federal personal income taxes as a function of this base. Inasmuch as the state income tax in Alaska is tied to the federal tax, state income tax payments are estimated as a function of federal income tax payments. Miscellaneous tax and non-tax payments are then estimated as a function of personal income, and the sum of federal, state, and miscellaneous tax payments constitutes the difference between personal income and disposable personal income.

As mentioned above, a further function of the fiscal model involves computing the levels of employment occurring within the government sectors. For the federal sector, employment is exogenously set. However, the determination of state and local government employment requires an explicit mode" ing of state and local revenues and expenditures, where elements of each involve policy choices rather than projections based on simple

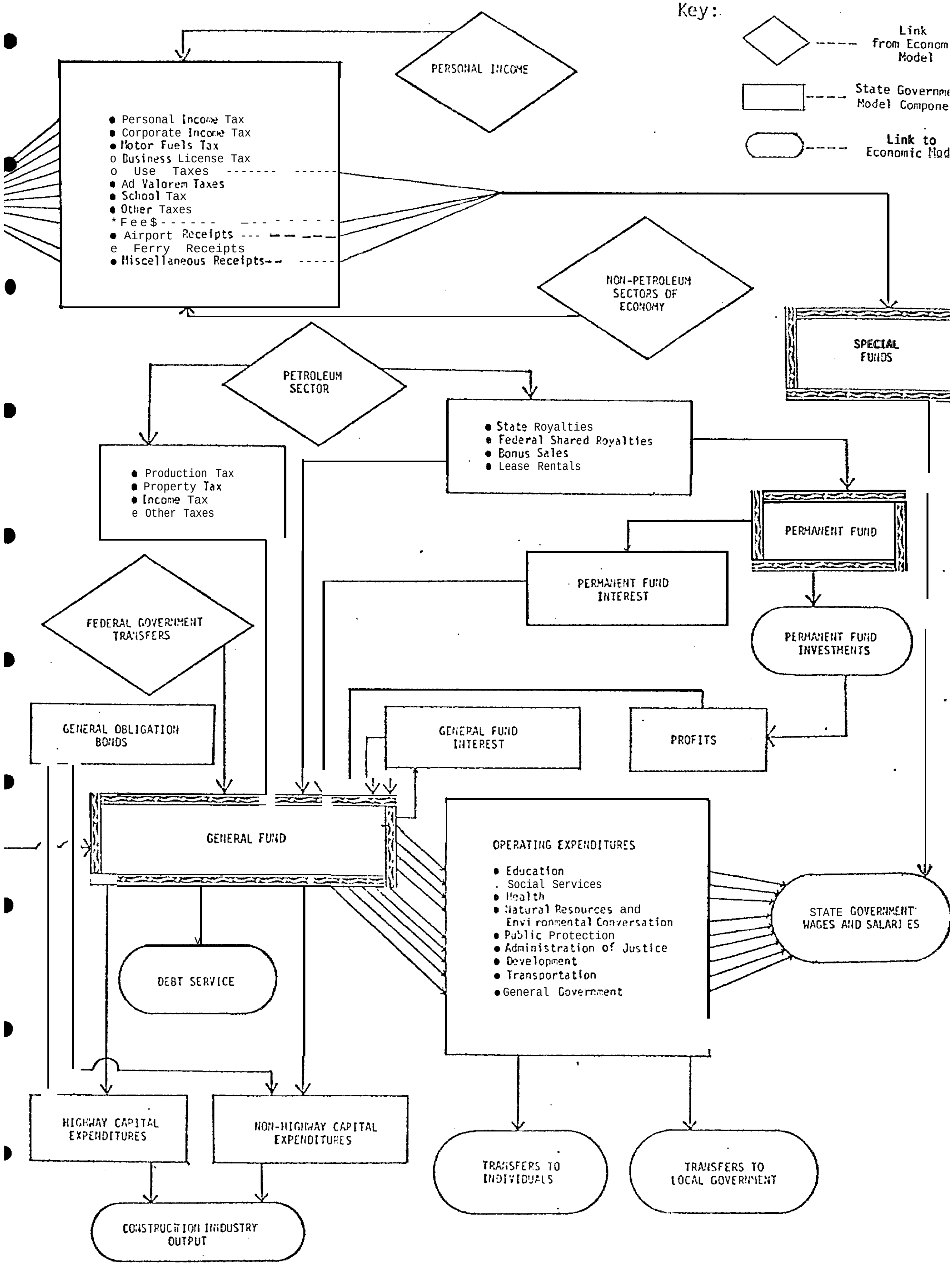

FIGURE A.3 MAP STATE GOVERNMENT MODEL STRUCTURE historical relationships. We turn now to an examination of how state and local revenues and expenditures are modeled.

At the state level, revenues are of three types. First, there are "endogenous" taxes, such as the personal income tax, corporate income tax, business license tax, and so on, which depend on the existing rate structure and the overall level of economic activity in the state. Such revenue items are modeled as functions of income, output, or some other indicator appropriate to the relevant tax base. A second type of revenues might be called “exogenous,” such as royalties, bonuses, and severance taxes, which depend not only on tax rates and state leasing procedures, but largely on factors outside the state’s control such as world oil prices, transportation costs, geology, federal policy, and so on. These revenue estimates are developed outside of the model as part of the development scenario. A third type of revenues, mainly federal grants, contains both endogenous and exogenous components (such as revenue sharing being tied to population, while impact grants for coastal zone management are exogenous).

State expenditure determination in the model consists largely of a series of policy choices. First, the total expenditure level must be determined. Second, the allocation of expenditures between capital and current expenditure level must be determined. In the model, total state expenditures are given by an assumed expenditure rule to be specified as part of the non-OCS development scenario. Such a rule might be to let real per capita expenditures grow at an exogenously determined rate, to hold real per capita expenditures constant, or to save a fixed proportion of revenues so long as real per capita expenditures fall above some maximum. Once the total is determined, capital expenditures are specified exogenously, thus determining total current expenditures. Current expenditures by functional category are then determined as a function of total current expenditures. Personal services expenditures by function are then determined as a function of current expenditures by function, and wages and salaries of the state government are then determined from the sum of personal service expenditures for each functional category.

At the local government level, revenues are received from four major sources--local property taxes, other local taxes and fees, grants from the state government, and grants from the federal government. Local property taxes are estimated as a function of the local property tax base. Other taxes and fees are estimated as a function of personal income. State grants are estimated by a series of equations in which aid is tied to local population, school enrollment, and several exogenous items. Federal grants are simply exogenous.

The level of total expenditures of the local government, unlike the state, is modeled not as a policy choice, but rather is simply set equal to total revenues and divided between two categories, educational and non-educational expenditures, according to historical relationship.*

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*However, the model is set up to permit the introduction of an exogenous amount of savings at the local level, which might occur as a consequence of receipt of oil-related revenues (property taxes, etc.).

Capital expenditures are estimated as a function of educational expenditures, and personal expenditures are estimated as a function of total expenditures less capital expenditures. Wages and salaries of the local government sector are then estimated as a function of personal expenditures.

The sum of wage and salary payments by the state and local governments is finally transmitted to the economic model and divided by the estimated wage rate for the state and local sector to arrive at state and local government employment.

LINKAGES BETWEEN MODEL COMPONENTS

Figure A-4 represents schematically the relationships between the various model components. The economic model requires the total of wage and salary payments by state and local governments from the fiscal model in order to estimate state and local government employment and capital expenditure to estimate a component of construction sector employment. Furthermore, the economic model requires individual tax payments data from the fiscal model to arrive at disposable personal income. On the other hand, the fiscal model requires estimated personal income from the economic model to estimate personal tax payments. The population model requires estimated real non-Native per capita disposable income and changes in employment from the economic model to estimate net migration, and a total population estimate is required to estimate several items of state and local revenues in the fiscal model.

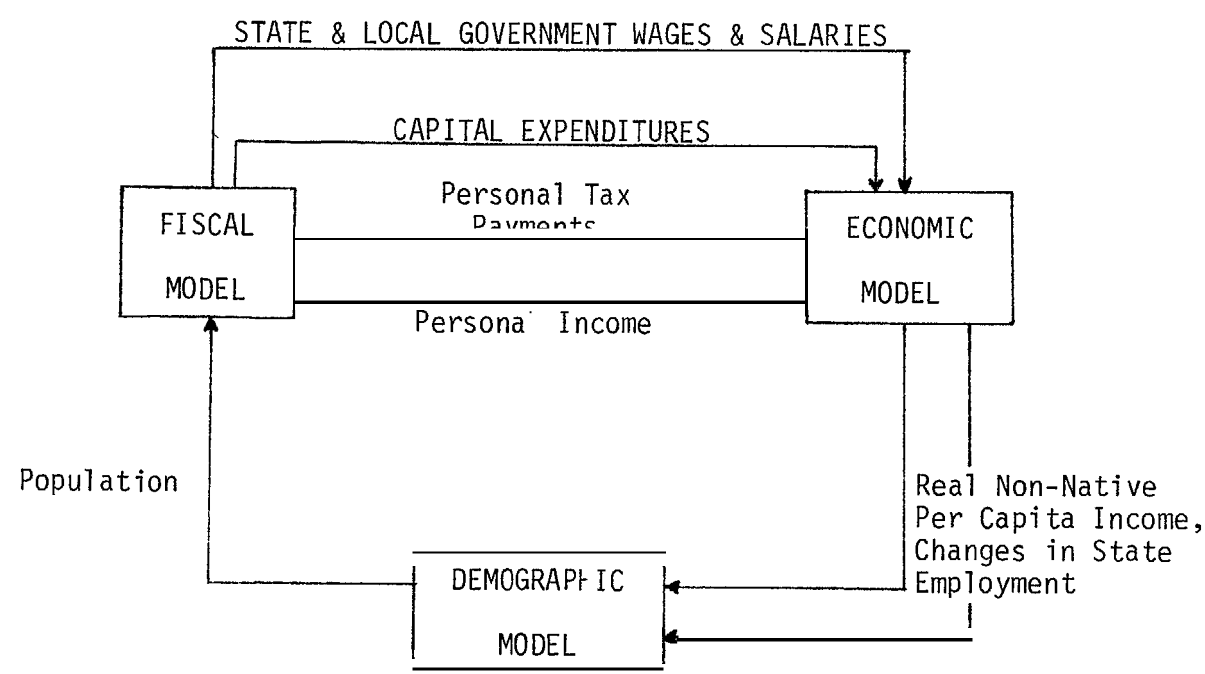

FIGURE A.4 MAJOR LINKAGES BETWEEN MAP MODEL COMPONENTS

The Regional Model

Unlike the statewide MAP model which contains full fiscal, demographic, and economic components, the Beaufort version of the regional model contains no fiscal component. It cannot be run independently, but rather is designed to be run in tandem with the state model. The function of the regional model is simply to disaggregate statewide totals to a regional level.

THE REGIONS

Unlike previous versions of the MAP regional model, the current version uses a slightly different regionalization to reflect changes in labor market area definition beginning with the 1975 wages, salary, and employment data by the Alaska Department of Labor's Statistical Quarterly. Figure A-5 presents the new regionalization used in the Beaufort.

The North Slope and Central regions are a disaggregation of the areas formerly included in the Northwest and Interior MAP regions. Data for the area containing these regions was used to estimate all of the equations in the regional model. The equations were disaggregate by adjusting the constant in each equation to reflect the latest data point. Separate equations for the North Slope region could not be estimated because data is only available for the region since 1975.

THE ECONOMIC MODEL

The economic component of the MAP model is designed to produce regional forecasts of incomes, output, and employment. Within each region, industries are broken down into eighteen sectors, as shown in Table A-2.

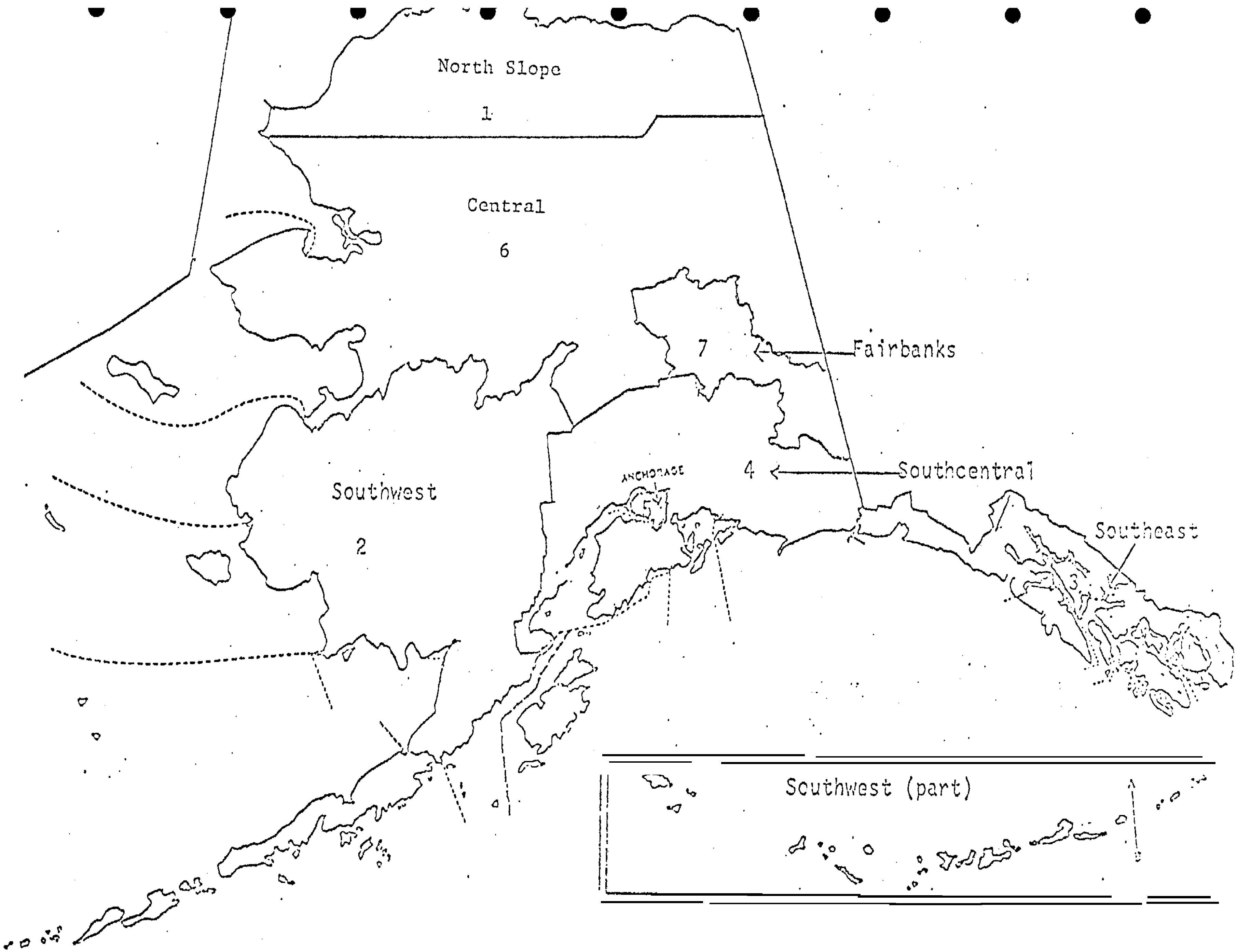

FIGURE A.5. MAN-IN-THE-ARCTIC PROGRAI R G ONS

TABLE A.2. REGIONAL MODEL INDUSTRIAL CLASSIFICATION

1. Agriculture
2. Forestry
3. Fisheries
4. Food Manufacturing
5. Lumber Manufacturing
6. Paper Manufacturing
7. Other Manufacturing
8. Air Transportation
9. Other transportation
10. Communications
11. Public Utilities
12. Wholesale Trade
13. Retail Trade
14. Finance
15. Services
16. Federal Government
17. State and Local Government
18. Construction

Manufacturing is subdivided into food, lumber, paper, and other. Transportation is subdiv ted into air and other. Trade is subdivided into wholesale and retail.

Output in each endogenous sector is a function of reg onal wages and salaries, rather than real disposable personal income, Sectoral employment is determined as a function of sectoral output, and wage rates are determined as in the state model. Sectoral wages and salaries are then calculated as the product of sectoral wage rates and employment. The sum of sectoral wages and salaries is regional wages and salaries, which acts to determine regional sectoral outputs.

The forecasts presented by the regional mode are the regionalized equivalents of the output, employment, and income forecasts presented by the statewide model, subject to minor difference: due to stochastic variation.

THE DEMOGRAPHIC MODEL

The regional demographic model presents only total population estimates by region. It does not estimate an age-sex distribution at the regional level.

RELATIONSHIP TO STATEWIDE MODEL

As mentioned previously, the Beaufort version of the regional model cannot be run independently of the statewide model. The run of the statewide model presents a pattern of wages and salary payments to state and local government workers. The regional model, though having no fiscal model, accepts this pattern as exogenous and uses it in the calculation of regional state and local government employment.

APPENDIX B

BASE CASE ASSUMPTIONS

1977 - 2000

TABLE 6.1. NORTH SLOPE MINING INDUSTRY EMPLOYMENT
-BASE CASE-
(Thousands of Persons)

Year	Prudhoe Bay[1]	TAPS[2]	Other Prudhoe[3]	ALCAN[4]	Mining[5]	Total
1977	1.5	.000	.055	.000	.200	1.755
1978	1.1	.021	.055	.000	.200	1.376
1979	.9	.021	.874	.000	.200	1.995
1980	.6	.021	.923	.015	.200	1.759
1981	.6	.021	1.619	.015	.200	2.455
1982	.6	.021	1.710	.015	.200	2.546
1983	.5	.021	1.801	.015	.200	2.537
1984	.5	.021	1.892	.015	.200	2.628
1985	.45	.021	1.983	.015	.200	2.669
1986	.45	.021	2.074	.015	.200	2.760
1987	.45	.021	1.814	.015	.200	2.500
1988	.45	.021	.948	.015	.200	1.634
1989	.45	.021	.728	.015	.200	.414
1990	.45	.021	.728	.015	.200	.414
1991	.45	.021	.728	.015	.200	.414
1992	.45	.021	.728	.015	.200	.414
1993	.45	.021	.728	.015	.200	.414
1994	.45	.021	.728	.015	.200	.414
1995	.45	.021	.728	.015	.200	.414
1996	.45	.021	.728	.015	.200	1.414
1997	.45	.021	.728	.015	.200	1.414
1998	.45	.021	.728	.015	.200	1.414
1999	.45	.021	.728	.015	.200	1.414
2000	.45	.021	.728	.015	.200	1.414

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[1]Based on estimates in Issues in Alaska's Development (Kresge, et al), Table B-1.

[2]Author's estimate of operations employment.

[3]Author's estimate based on reserves and development schedule in "Developing Production and Price Estimates for North Alaska Oil and Gas Supplies" (FEA, 1975).

[4]Author's estimate of operations employment.

[5]Based on residual for 1975 mining employment estimates.

TABLE B.2. ANCHORAGE MINING INDUSTRY EMPLOYMENT
-BASE CASE-
(Thousands of Persons)

Year	Total Mining Employment
1977	1.002
1978	1.002
1979	1.002
1980	1.009
1981	1.009
1982	1.009
1983	1.009
1984	1.009
1985	1.009
1986	1.009
1987	1.009
1988	1.009
1989	1.009
1990	1.009
1991	1.009
1992	1.009
1993	1.009
1994	1.009
1995	1.009
1996	1.009
1997	1.009
1998	1.009
1999	1.009
2000	1.009

SOURCE: Author's estimate based on 1975 mining employment estimate.

TABLE B.3. FAIRBANKS MINING INDUSTRY EMPLOYMENT
-BASE CASE-
(Thousands of Persons)

Year	TAPS[1]	ALCAN[1]	Other Mining Employment	Total
1977	.000	.000	.131	.131
1978	.135	.000	*131	.266
1979	.135	.000	.131	.266
1980	.135	* 043	.131	.309
1981	.135	.043	.131	.309
1982	.135	.043	.131	.309
1983	.135	.043	.131	.309
1984	.135	.043	.131	.309
1985	.135	.043	.131	.309
1986	.135	.043	.131	.309
1987	.135	. 043	.131	.309
1988	.135	.043	.131	.309
1989	.135	.043	.131	,309
1990	.135	.043	.131	.309
1991	.135	.043	.131	.309
1992	.135	.043	.131	.309
1993	.135	.043	.131	.309
1994	.135	.043	.131	.309
1995	.135	.043	.131	.309
1996	.135	.043	.131	.309
1997	.135	.043	.131	. 309
1998	.135	.043	.131	.309
1999	.135	.043	.131	.309
2000	.135	.043	.131	.309

[1]Author's estimate of operations employment.

[2]Author's estimate based on 1975 mining employment.

TABLE B.4. NORTH SLOPE EXOGENOUS CONSTRUCTION EMPLOYMENT, BY PROJECT
-BASE CASE-
(Thousands of Persons)

Year	TAPS[1]	AL CAN	Total
1977	.404	.000	.404
1978	.063	.000	.063
1979	.021	.523	.544
1980	.000	1.431	1.431
1981	.000	1.197	1.197
1982	.000	.062	.062
1983	.000	.000	.000
1984	.000	.000	.000
1985	.000	.000	.000
1986	.000	.000	.000
1987	.000	.000	.000
1988	.000	.000	.000
1989	.000	.000	.000
1990	.000	.000	.000
1991	.000	.000	.000
1992	.000	.000	.000
1993	.000	.000	.000
1994	.000	.000	.000
1995	.000	.000	.000
1996	.000	.000	.000
1997	.000	.000	.000
1998	.000	.000	.000
1999	.000	.000	.000
2000	.000	.000	.000

[1]Allocation of state total based on estimate of miles of pipeline in region.

TABLE B.5. ANCHORAGE EXOGENOUS CONSTRUCTION EMPLOYMENT, BY PROJECT
-BASE CASE-
(Thousands of Persons)

Year	ALCAN[1]	Total
1977	.000	.000
1978	.000	.000
1979	.229	.229
1980	.626	.626
1981	.524	.524
1982	.027	.027
1983	.000	.000
1984	.000	.000
1985	.000	.000
1986	.000	.000
1987	.000	.000
1988	.000	.000
1989	.000	.000
1990	.000	.000
1991	.000	.000
1992	.000	.000
1993	.000	.000
1994	.000	.000
1995	.000	.000
1996	.000	.000
1997	.000	.000
1998	.000	.000
1999	.000	.000
2000	.000	.000

[1] Author's estimate of Alcan headquarters personnel.

TABLE B.6. FAIRBANKS EXOGENOUS CONSTRUCTION EMPLOYMENT, BY PROJECT
-BASE CASE-
(Thousands of Persons)

Year	TAPS[1]	ALCAN[1]	Total
1977	2.599	.000	2.599
1978	.405	.000	.405
1979	.135	1.472	1.607
1980	.000	4.024	4.024
1981	.000	3.367	3.367
1982	.000	.176	.176
1983	.000	.000	.000
1984	.000	.000	.000
1985	.000	.000	.000
1986	,000	.000	.000
1987	.000	.000	.000
1988	.000	.000	.000
1989	.000	.000	.000
1990	.000	.000	.000
1991	.000	.000	.000
1992	.000	.000	.000
1993	.000	.000	.000
1994	.000	.000	.000
1995	.000	.000	.000
1996	.000	.000	.000
1997	.000	.000	.000
1998	.000	.000	.000
1999	.000	.000	.000
2000	.000	.000	.000

[1]Allocation of state total based on estimate of miles of pipeline in region.

TABLE B.7. OIL AND GAS PRODUCTION FROM PRUDHOE AND VICINITY
-BASE CASE-

Year	Gas[1] (mmcfpd)	Oil[2] (mmbpd)
1977	7.67	0.300
1978	10.69	1.000
1979	13.97	1.600
1980	16.16	1.600
1981	76.71	1.664
198'2	117.81	1.665
1983	2129.86	1.730
1984	2268.49	1 .730
1985	2380.00	1.785
1986	2383.56	1.575
1987	2383.56	1.415
1988	2383.56	1.390
1989	2383.56	1.215
1990	2383.56	1.030
1991	2383.56	0.985
1992	2383.56	0.920
1993	2383.56	0.885
1994	2383.56	0.655
1995	2383.56	0.715
1996	2027.39	0.635
1997	1723.29	0.615
1998	1463.01	0.545
1999	1243.84	0.537
2000	1057.53	0.470

[1] From "The Permanent Fund and the Growth of the Alaskan Economy" (Goldsmith, 1977), Table C.2.

[2] From "Beaufort Sea Petroleum Development Scenarios for the State-Federal and Federal Outer Continental Shelf" (Dames and Moore, 1978), Table 11.

TABLE B.8. WELLHEAD VALUE OF OIL AND GAS PRODUCTION FROM PRUDHOE AND VICINITY -BASE CASE-

Year	Gas[1] ($/mcf)	Oil[2] ($/bbl)
1977	.25	5.23
1978	.25	5.48
1979	.25	6.01
1980	.25	7.17
1981	.25	7.84
1982	.25	8.54
1983	.25	9.28
1984	.25	10.06
1985	.25	10.86
1986	.25	11.72
1987	.25	12.61
1988	.25	13.55
1989	.25	14.55
1990	.25	15.58
1991	.25	16.67
1992	.25	17.82
1993	.25	19.02
1994	.25	20.28
1995	.25	21.60
1996	.25	22.98
1997	.25	24.44
1998	.25	25.98
1999	.25	27.59
2000	.25	29.28

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[1] Implicit in "The Permanent Fund and the Growth of the Alaskan Economy" (Goldsmith, 1977), Table C.2.

‘Author's estimate assumes:

a. a 1977 refinery price of $12.86 increasing 5% annually;
b. a constant TAPS tariff of $6.20; and
c. a tankering charge from Valdez to the Lower 48 of $1.43 in 1977, increasing to $4.01 by 2000.

[redacted]

APPENDIX C

STATE REVENUE AND EXPENDITURE DETAIL

(BASE CASE AND IMPACTS)

TABLE Cl. STATE REVENUE DETAIL
BASE CASE
1977-2000
(Millions of Dollars)

Year	Total Revenues	Personal Income Taxes	Corporate Taxes	Total Taxes	Total Direct Petroleum Revenues	General Fund Interest	Permanent Fund Interest
1977	1,133.540	112.151	22.244	205.879	503.300	34.023	0.000
1978	1,225.480	100.477	19.629	183.687	590.600	48.716	3.009
1979	1,391.290	103.475	19.534	187.307	724.500	48.716	10.313
1980	1,693.450	120.831	22.512	215.326	949.650	47.247	24.026
1981	1,926.870	138.086	28.126	248.523	1,093.050	47.247	42.541
1982	2,177.690	139.973	31.181	257.077	1,291.150	47.247	63.823
1983	2,450.060	137.709	30.163	252.203	1,525.450	47.247	87.317
1984	2,738.780	145.205	32.070	264.961	1,745.550	47.247	114.166
1985	3,029.670	154.907	34.766	282.352	1,952.300	47.247	147.695
1986	3,177.570	165.951	38.627	303.759	2,005.200	47.247	184.378
1987	3,180.160	174.062	41.627	319.303	1,920.350	47.247	223.037
1988	3,245.690	179.246	43.872	329.558	1,913.300	42.236	260.167
1989	3,290.81	185.569	45.477	339.621	1,884.050	36.382	297.609
1990	3,235.220	194.657	48.515	356.234	1,746.450	26.492	334.830
1991	3,241.970	205.523	51.790	375.244	1,676.350	7.668	369.301
1992	3,316.030	217.102	55.869	396.986	1,676.450	0.000	384.079
1993	3,394.130	229.612	59.751	419.030	1,680.200	0.000	387.815
1994	3,330.050	243.010	64.592	444.200	1,539.250	0.000	387.132
1995	3,328.750	257.551	69.341	470.309	1,470.200	0.000	372.244
1996	3,430.280	272.945	75.145	499.559	1,507.750	0.000	346.227
1997	3,455.980	289.657	80.821	529.748	1,467.250	0.000	316.550
1998	3,482.010	307.627	87.854	564.359	1,427.750	0.000	276.210
1999	3,518.720	327.228	94.856	600.333	1,402.000	0.000	225.338
2000	3,551.040	348.646	103.530	641.879	1,370.800	0.000	162.692

SOURCE : MAP Statewide Model

TABLE C.2. STATE EXPENDITURE DETAIL
BASE CASE
1977-2000

Year	Total State Expenditures (millions of $)	Current Expenditures (millions of $)	Capital Expenditures (millions of $)	Real Per Capita State Expenditures
1977	980.650	690.650	290.000	968.992
1978	1,231.140	901.138	330.000	1,174.460
1979	1,335.500	988.899	346.603	1,174.460
1980	1,562.770	1,176.630	386.141	1,219.390
1981	1,766.840	1,350.420	416.422	1,279.650
1982	1,987.560	1,553.910	433.648	1,424.730
1983	2,218.530	1,758.940	459.597	1,521.430
1984	2,434.070	1,946.720	487.344	1,585.150
1985	2,661.160	2,142.210	518.944	1,631.380
1986	2,803.240	2,259.420	543.821	1,639.130
1987	2,905.720	2,345.020	560.708	1,639.130
1988	2,983.780	2,406.660	577.121	1,639.130
1989	3,096.860	2,500.040	596.819	1$639.120
1990	3,215.680	2,601.470	614.204	1,639.120
1991	3,353.030	2,703.890	649.137	1,639.120
1992	3,483.520	2,802.610	680 .903	1,639.120
1993	3,634.200	2,923.510	710.688	1,639.120
1994	3,782.370	3,041.820	740.551	1,639.120
1995	3,950.650	3,176.670	773.971	1,639.120
1996	4,114.770	3,307.480	807.285	1,639.120
1997	4,304.710	3,459.630	845.082	1,639.120
1998	4,493.020	3,609.750	883.265	1,639.120
1999	4,711.630	3,784.910	926.723	1,639.120
2000	4,935.700	3,963.980	971.720	1,639.120

SOURCE : MAP Statewide Model

TABLE C.3. STATE REVENUE IMPACTS
(measured as change
from the base)
PRUDHOE HIGH, 1977-2000
(Millions of Dollars)

Year	Total Revenues	Personal Income Taxes	Corporate Taxes	Total Taxes	Total Direct Petroleum Revenues	General Fund Interest	Permanent Fund Interest
1977	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.257	0.089	0.000	0.116	0.000	0.000	0.000
1980	126.338	0.351	0.042	0.547	125.350	-0.064	0.000
1981	136.453	0.585	0.121	1.019	125.850	-0.064	8.750
1982	21.580	0.735	0.166	1.315	1.600	-0.064	17.500
1983	23.431	0.886	0.222	1.612	2.899	-0.064	17.500
1984	25.373	0.978	0.249	1.781	4.449	-0.064	17.500
1985	29.149	1.253	0.287	2.200	7.349	-0.064	17.500
1986	53.469	4.249	0.417	6.163	23.649	-0.064	17.500
1987	93.841	8.126	1.981	14.175	51.349	-0.654	17.500
1988	238.795	8.884	2.377	16.012	190.649	0.413	17.499
1989	477.1.52	10.287	2.735	18.839	412.899	6.267	20.541
1990	682.060	12.239	3.690	23.264	590.800	16.157	29.163
1991	886.073	13.461	4.176	25.747	757.799	34.144	42.498
1992	,068.58	14.945	4.773	28.786	889.499	41.812	78.658
1993	,184.520	16.416	5.556	32.148	9470300	41.812	129.577
1994	,229.420	17.316	6.186	34.498	929.648	41.729	186.771
1995	,218.210	18.268	6.597	36.397	854.599	32.512	254.696
1996	,175.870	19.765	7.385	39.759	748.949	12.575	330.424
1997	,119.900	21.454	8.216	43.403	634.100	0.000	393.658
1998	,074.530	23.367	9.252	47.729	534.950	0.000	437.937
1999	,046.020	25.573	10.378	52.540	457.300	0.000	476.439
2000	,027.050	28.067	11.807	58.300	392.500	0.000	509.929

SOURCE : MAP Statewide Model

TABLE C.4. STATE EXPENDITURE IMPACTS
(measured as change from the base)
PRUDHOE HIGH, 1977-2000

Year	Total State Expenditures (millions of $)	Current Expenditures (millions of $)	Capital Expenditures (millions of $)	Real Per Capita State Expenditures
1977	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000
1979	1.293	1.092	0.200	0.000
1980	1.629	1.066	0.563	-1.509
1981	11.881	10.576	1.305	4.611
1982	22.173	20.074	2.098	9.831
1983	24.114	21.762	2.352	9.419
1984	26.162	23.522	2.640	8.906
1985	30.213	26.907	3.306	7.900
1986	65.931	56.358	9.572	0.146
1987	83.734	70.190	13.544	0.146
1988	118.031	97.297	20.733	8.314
1989	221.092	188.749	32.343	43.033
1990	244.208	202.777	41.431	43.034
1991	270.910	233.091	37.818	43.294
1992	353.839	314.280	39.559	65.836
1993	383.667	339.260	43.406	65.837
1994	405.757	365.782	39.975	65.837
1995	437.683	401.024	36.659	65.835
1996	470.207	423.811	46.396	65.835
1997	507.098	446.670	60.428	65.835
1998	546.090	480.247	65.842	65.836
1999	591.312	519.215	72.096	65.837
2000	638.793	560.072	78.718	65.835

SOURCE: MAP Statewide Model

TABLE C.5. STATE REVENUE IMPACTS
(measured as change from the base)
PRUDHOE LOW, 1977-2000
(Millions of Dollars)

Year	Total Revenues	Personal Income Taxes	Corporate Taxes	Total Taxes	Total Direct Petroleum Revenues	General Fund Interest	Permanent Fund Interest
1977	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	125.243	0.087	0.000	0.112	125.000	0.000	0.000
1981	135.456	0.444	0.043	0.669	125.350	0.000	8.750
1982	21.019	0.806	0.188	1.448	0.800	0.000	7.500
1983	22.052	0.884	0.229	1.637	1.449	0.000	7.500
1984	23.381	0.927	0.241	1.697	2.600	0.000	7.500
1985	24.638	0.927	0.265	1.747	3.699	0.000	7.500
1986	27.736	1.187	0.263	2.062	6.049	0.000	7.500
1987	41.429	3.123	0.434	4.791	14.300	0.000	7.500
1988	59.789	5.305	1.377	9.456	25.799	-1.002	7.499
1989	121.324	6.031	1.586	10.837	84.399	-1.418	7.500
1990	210.137	6.477	1.987	12.337	167.250	0.184	8.747
1991	270.267	6.590	1.991	12.484	217.400	5.742	21.979
1992	330.437	7.087	2.274	13.674	262.650	0.000	39.981
1993	385.664	7.719	2.462	14.816	299.100	0.000	55.888
1994	429.596	8.800	2.893	16.998	319.550	0.000	74.717
1995	468.312	9.871	3.403	19.357	332.450	0.000	95.519
1996	515.194	10.560	3.891	21.170	352.950	0.000	118.002
1997	593.367	10.875	4.151	22.023	403.650	0.000	143.096
1998	627.918	11.439	4.430	23.206	405.150	0.000	173.011
1999	597.507	11.770	4.940	24.606	340.350	0.000	204.368
2000	599.341	11.910	4.985	24.758	311.800	0.000	233.312

SOURCE : MAP Statewide Model

TABLE C.6. STATE EXPENDITURE IMPACTS
(measured as change from the base)
PRUDHOE LOW, 1977-2000

Year	Total State Expenditures (millions of $)	Current Expenditures (millions of $)	Capital Expenditures (millions of $)	Real Per Capita State Expenditures
1977	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000
1980	0.346	0.158	0.187	-0.720
1981	10.895	9.629	1.265	3.818
1982	21.612	19.547	2.065	9.432
1983	22.693	20.486	2.207	8.886
1984	24.101	21.683	2.417	8.291
1985	25.378	22.850	2.528	8.169
1986	28.818	25.546	3.271	6.525
1987	58.656	51.609	7.046	6.526
1988	69.252	60.144	9.108	6.529
1989	85.080	72.096	12.983	6.530
1990	89.275	72.785	16.489	6.531
1991	100.491	90.333	10.157	6.532
1992	109.041	93.431	15.608	6.531
1993	123.372	105.536	17.835	6.532
1994	140.114	119.663	20.451	6.533
1995	155.702	132.802	22.900	6.531
1996	165.875	141.332	24.542	6.531
1997	175.723	149.593	26.129	6.530
1998	190.551	162.053	28.497	6.529
1999	194.793	165.567	29.225	6.529
2000	208.641	177.197	31.443	6.527

SOURCE : MAP Statewide Model

TABLE C.7. STATE REVENUE IMPACTS
(measured as change from the base)
CAMDEN-CANNING, 1977-2000
(Millions of Dollars)

Year	Total Revenues	Personal Income Taxes	Corporate Taxes	Total Taxes	Total Direct Petroleum Revenues	General Fund Interest	Permanent Fund Interest
1977	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	125.002	0.000	0,000	0.000	125.000	0.000	0.000
1981	134.022	0.081	0.000	0.107	125.000	0.000	8.750
1982	18.944	0.410	0.053	0.646	0.100	0.000	17.500
1983	20.750	0.818	0.183	1.451	0.499	0.000	17.500
1984	22.032	1.009	0.254	1.839	1.049	0.000	17.500
1985	22.958	1.020	0.289	1.932	1.750	0.000	17.500
1986	25.839	1.250	0.282	2.186	3.999	0.000	17.500
1987	36.539	2.461	0.441	3.997	11.200	0.000	17.500
1988	60.150	5.050	0.962	8.239	27.299	-0.358	17.499
1989	85.288	6.982	1.892	12.544	45.649	-1.040	17.500
1990	211.581	8.260	2.056	14.524	166.450	-0.631	17.500
1991	421.934	10.163	2.973	18.896	361.150	3.972	20.122
1992	591.347	11.177	3.414	21.104	504.599	0.000	44.856
1993	750.483	12.200	3.972	23.566	626.999	0.000	76.117
1994	897.615	13.344	4.405	25.833	727.449	0.000	117.426
1995	1,033.980	14.865	5.111	29.080	806.798	0.000	167.514
1996	1,150.470	15.391	5.800	31.097	860.699	0.000	225.691
1997	1,217.250	15.678	5.854	31.460	859.250	0.000	291.536
1998	1,268.250	16.447	6.548	33.732	836.049	0.000	360.724
1999	1,304.450	16.817	6.859	34.722	797.049	0.000	432.682
2000	1,327.770	17.860	7.415	36.995	741.349	0.000	506.126

SOURCE : MAP Statewide Model

TABLE C.8. STATE EXPENDITURE IMPACTS
(measured as change from the base)
CAMDEN-CANNING, 1977-2000

Year	Total State Expenditures (millions of $)	Current Expenditures (millions of $)	Capital Expenditures (millions of $)	Real Per Capita State Expenditures
1977	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000
1980	0.003	0.001	0.001	-0.004
1981	9.152	8.480	0.672	5.415
1982	19.394	17.685	1.708	9.376
1983	21.382	19.270	2.111	8.177
1984	22.772	20.400	2.372	7.299
1985	23.707	21.260	2.446	7.150
1986	26.913	23.761	3.152	5.587
1987	43.761	38.329	5.432	5.586
1988	73.826	64.038	9.788	5.590
1989	83.989	71.827	12.162	5.590
1990	114.741	94.850	19.890	5.593
1991	132.835	116.236	16.599	5.593
1992	153.484	130.793	22.691	5.593
1993	170.082	144.745	25.336	5.594
1994	193.164	164.168	28.995	5.594
1995	215.292	182.769	32.523	5.593
1996	222.652	188.832	33.820	5.593
1997	242.859	205.781	37.078	5.592
1998	254.980	215.864	39.116	5.594
1999	270.875	229.149	41.726	5.593
2000	293.758	248.322	45.432	5.592

SOURCE: MAP Statewide Model

TABLE C.9. STATE REVENUE IMPACTS
(measured as change from the base)
CAPE HALKETT, 1977-2000
(Millions of Dollars)

Year	Total Revenues	Personal Income Taxes	Corporate Taxes	Total Taxes	Total Direct Petroleum Revenues	General Fund Interest	Permanent Fund Interest
1977	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.156	0.057	0.000	0.071	0.000	0.000	0.000
1985	0.863	0.236	0.031	0.368	0.149	0.000	0.000
1986	1.953	0.455	0.094	0.780	0.499	0.000	0.000
1987	2.256	0.400	0.149	0.829	0.800	0.000	0.000
1988	3.212	0.397	0.055	0.613	1.749	0.197	0.000
1989	9.747	1.336	0.171	1.994	5.599	0.245	0.000
1990	25.082	3.434	0.590	5.405	14.899	-0.050	0.000
1991	40.211	4*734	1.391	8.656	25.399	-0.829	0.000
1992	65,055	4.817	1.332	8.675	48.899	0.000	-0.660
1993	88.480	5.506	1.736	10.503	67.500	0.000	0.344
1994	87.789	5.995	1.953	11.540	62.249	0.000	2.468
1995	88.821	6.611	2.225	12.833	58.899	0.000	3.941
1996	92.452	7.271	2.547	14.276	58.449	0.000	4.828
1997	93.758	7.797	2.884	15.578	56.399	0.000	5.286
1998	94.686	8.303	3.133	16.653	54.599	0.000	5.321
1999	95.423	8.759	3.527	17.975	53.049	0.000	4.701
2000	95.282	9.161	3.724	18.794	51.550	0.000	3.727

SOURCE: MAP Statewide Model

TABLE C.10. STATE EXPENDITURE IMPACTS
(measured as change from the base)
CAPE HALKETT, 1977-2000

Year	Total State Expenditures (millions of $)	Current Expenditures (millions of $)	Capital Expenditures (millions of $)	Real Per Capita State Expenditures
1977	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000
1984	0.223	0.101	0.122	-0.541
1985	1.061	0.681	0.379	-1.312
1986	2.273	1.629	0.644	-1.702
1987	-0.410	-0.806	0.395	-1.704
1988	2.906	2.099	0.807	-1.702
1989	15.106	12.665	2.440	-1.701
1990	38.821	33.069	5.752	-1.699
1991	40.515	33.275	7.239	-1.698
1992	54.286	45.450	8.835	-1.699
1993	62.216	52.076	10.139	-1.699
1994	71.392	59.744	11.648	-1.698
1995	81.430	68.129	13.301	-1.700
1996	91.832	76.807	15.024	-1.700
1997	99.699	83.330	16.368	-1.702
1998	110.648	92.447	18.201	-1.703
1999	116.836	97.528	19.307	-1.703
2000	128.129	106.914	21.214	-1.705

SOURCE : MAP Statewide Model

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Glossary of Variable Names
Beaufort OCS Petroleum Development Scenarios:
Economic and Demographic Impacts

Regions - denoted by suffix R-

R1 - North Slope
R2 - Southwest
R3 - Southeast
R4 - Southcentral
R5 - Anchorage
R6 - Central
R7 - Fairbanks

Scenarios

OCS.PL - Prudhoe High
OCS.PS - Prudhoe Low
OCS.CC - Camden-Canning
OCS.HK - Cape Halkett
OCS.SD - Smith-Dease
OBASE.26 - Base Case

When Suffix -ER this is change from the base case.

Variables

Symbol	Variable	Units
POP	Total Population	Thousands of People
POPC	Civilian Population	" " "
PON	Native Population	" " "
POPM	Military Population	" " "
ECONX	Exogenous Construction Employment	" " "
EMP9	Mining Employment	" " "
EM99	Total Employment	Thousands of Wage Earners
EMP9	Mining	" " " "
EMCN	Construction	" " " "
EMM9	Total Manufacturing	" " " "
EMMF	Food Manufacturing	" " " "
EMMP	Paper Manufacturing	" " " "
EMML	Lumber Manufacturing	" " " "

Symbol	Variable	Units
EMMO	Other Manufacturing	Thousands of Wage Earners
EMT9	Total Transportation	" " " "
EMTA	Air Transportation	" " " "
EMTO	Other Transportation	" " " "
EMCM	Communication	" " " "
EMPU	Public Utilities	" " " "
EMD9	Total Trade	" " " "
EMDW	Wholesale Trade	" " " "
EMDR	Retail Trade	" " " "
EMFI	Finance, Insurance, Real Estate	" " " "
EMS9	Service	" " " "
EMGF	Federal Government	" " " "
EMGA	State and Local Government	" " " "
PI	Personal Income	" " " "
DPI	Disposable Personal Income	" " " "
PIPC	Per Capita Personal Income	" " " "
DPIR	Real Disposable Personal Income	" " " "
DIRPA	Real Disposable Personal Income Per Capita	" " " "
R99S	Total Revenues	Millions of Dollars
RTIS	Personal Income Taxes	" " "
RTCS	Corporate Taxes	" " "
RP9S	Total Direct Petroleum Revenues	" " "
RINS	General Fund Interest	" " "

Symbol	Variable	Units
RIPF	Permanent Fund Interest	Millions of Dollars
RT98	Total Taxes	" " "
E99S	Total State Expenditures	" " "
EXCUR	Current Expenditures	" " "
EXCAP	Capital Expenditures	" " "
E99SRPC	Real Per Capita State Expenditures	

The age and sex distribution of the population is described by a variable of the following form:

POP(F or M)(1-15)

POP - Total Population

NATP - Native Population

CNNP - Civilian Non-Native Population

F - Female

M - Male

Age Group: 1 is O-1

2 is 1-4

3 thru 14 are successive five year cohorts

15 is 65 and older