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ALASKA OCS SOCIOECONOMIC STUDIES PROGRAM

BERING-NORTON PETROLEUM DEVELOPMENT SCENARIOS
ECONOMIC AND DEMOGRAPHIC ANALYSIS

PREPARED FOR

BUREAU OF LAND MANAGEMENT
ALASKA OUTER CONTINENTAL SHELF OFFICE

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

Background

The progressive depletion of U.S. domestic petroleum reserves and increased concern over the reliability of foreign supplies have led to growing 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 7.6 percent of cumulative U.S. Outer Continental Shelf oil production by the end of 1978 (U.S. Geological Survey, 1979).

Alaska accounts for over one-fourth of the identified oil and gas reserves in the United States. 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 expected to be found in the Alaska OCS (U.S. Geological Survey, 1975).

Alaska's new role as a major U.S. energy supplier has already brought significant changes to the Alaska economy and society. 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 past federal lease sales in the Northern Gulf of Alaska, Lower Cook Inlet, and the Beaufort Sea.

Changes produced by past petroleum development in the state have been major. The rapid changes in the Alaska economy and population associated with the 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, however, will not necessarily resemble those characteristic of developments of the recent past. The technology, resource levels, and institutional arrangements surrounding Bering Sea developments are subject to a wide range of uncertainty. Consequently, the implications of Bering 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 Bering Sea-Norton Sound Basin. The Institute of Social and Economic Research, as part of the Bureau of Land Management's (BLM's) OCS Studies Program, has provided a series of economic and population forecasts through the year 2000 under several alternative scenarios for Bering Sea/Norton Sound 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.

Scope

This study consists of three major components. First, a baseline study examines the existing and historical structure of economic and demographic change within the regions most directly affected by the proposal, the Norton Sound and Anchorage regions, as well as in the state as a whole. Second, a set of forecasts are developed through the year 2000, based on the assumption that the proposed development does not occur. This base case then serves as a benchmark for comparison with an alternative set of forecasts premised on the occurrence of the proposed Bering-Norton OCS development. The final section presents an analysis of the impacts of these developments, measured as the difference between base case and OCS case forecast values.

Methodology for OCS Impact Assessment

The methodology to be used in assessing the impacts of the proposed federal OCS developments in the Bering Sea-Norton Sound area involves comparing two sets of economic and demographic projections--one contingent on the occurrence of the proposed development, and a second based on assumptions which omit the development. The impact of the development is measured as the difference between the two projections.

Because these projections are long range, there is a considerable degree of uncertainty associated with them. The specific future value of each and every forecast variable is unknown. However, certain such variables may be estimated from their statistical relationships to other such variables during the historical period. An econometric model is used to summarize these estimated structural relationships. Other variables, on the other hand, may not be estimated from historical data, either because they are determined by factors outside of the scope of the system under study or because they represent unique new situations not captured by historical data. While such variables (called exogenous) are neither known nor estimable with any degree of precision, the plausible range of values for such variables is quite often known. As a consequence, it is then feasible to develop a set of alternative forecasts, each contingent on assumed values of the exogenous variables, which span the plausible range of such variables and thus bracket the range of forecast variables. This section describes the models and exogenous assumptions required to develop a set of contingent forecasts, and it describes a methodology for utilizing such forecasts in assessing the impact of OCS development.

THE ECONOMETRIC MODELS

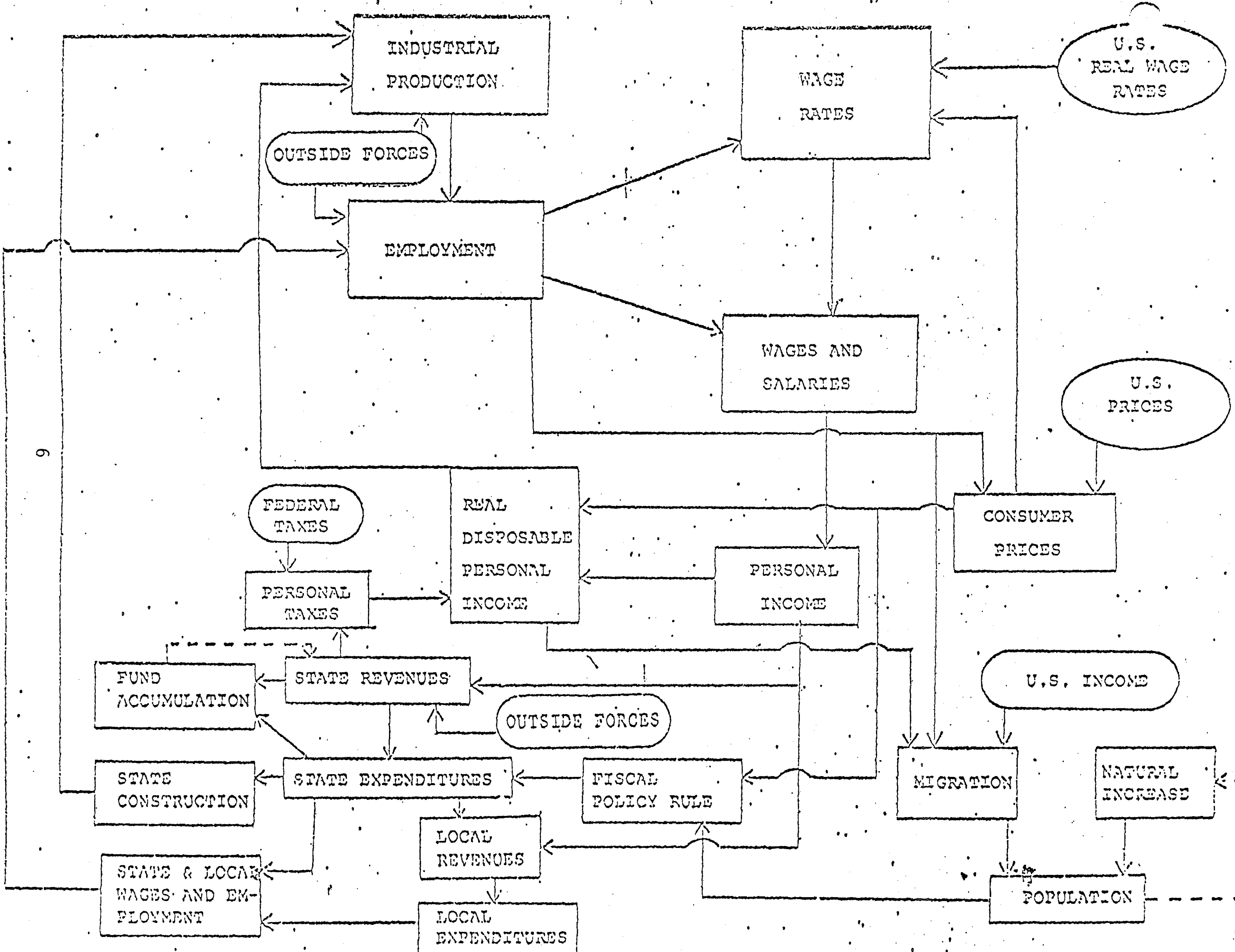
Two econometric models--a statewide model and a regional model designed to disaggregate the statewide results--are utilized in the analysis.

The Statewide Model

The principal model being utilized in the analysis of the proposed federal OCS development is the statwide econometric model developed by the Man-in-the-Arctic Program (MAP) at the University of Alaska Institute of Social and Economic Research. The model consists of three interrelated components: an economic model, a fiscal model, and a demographic model. The basic structure of the model is as shown in Figure 1.

The economic model is divided into exogenous or basic sectors and endogenous or nonbasic sectors. The level of output in the exogenous sectors is determined outside the state's economy. The primary reason for the nonbasic sector is to serve local Alaskan markets, so the level of output is determined within the Alaskan economy. The basic industries in the model are mining, agriculture-forestry-fisheries, manufacturing, federal government, and the export component of construction. The nonbasic industries are transportation-communication-utilities, wholesale and retail trade, finance-insurance-real estate, services, and the remainder of construction.

Industrial production in nonbasic industries determines the demand for labor and employment; employment is that level needed to produce the


INDUSTRIAL PRODUCTION
WAGE RATES
U.S. REAL WAGE RATES
OUTSIDE FORCES
EMPLOYMENT
WAGES AND SALARIES
U.S. PRICES
FEDERAL TAXES
REAL DISPOSABLE PERSONAL INCOME
CONSUMER PRICES
PERSONAL TAXES
PERSONAL INCOME
FUND ACCUMULATION
STATE REVENUES
U.S. INCOME
OUTSIDE FORCES
STATE CONSTRUCTION
STATE EXPENDITURES
FISCAL POLICY RULE
MIGRATION
NATURAL INCREASE
LOCAL REVENUES
STATE & LOCAL WAGES AND EMPLOYMENT
POPULATION
LOCAL EXPENDITURES

required output. The product of employment and the wage rate determine wages and salaries by industry. Aggregate wages and salaries are the major component of personal income. By assumption, the Alaska labor market is open to in- or out-migration from the Lower 49. In either case, labor demand is always satisfied. Wage rates in Alaska are determined in part by U.S. wage rates. Thus, both the supply and price of labor are linked to economic activity in the Lower 49. An estimate of disposable personal income is made by adding an estimate of nonwage income to wages and salaries and adjusting this by deducting income taxes. The level of real disposable income is found by deflating disposable personal income by a relative price index; the major determinants of Alaskan prices are U.S. prices, the size of the economy, and the growth rate of the economy. Incomes determine the demand for local production; incomes and output are simultaneously determined.

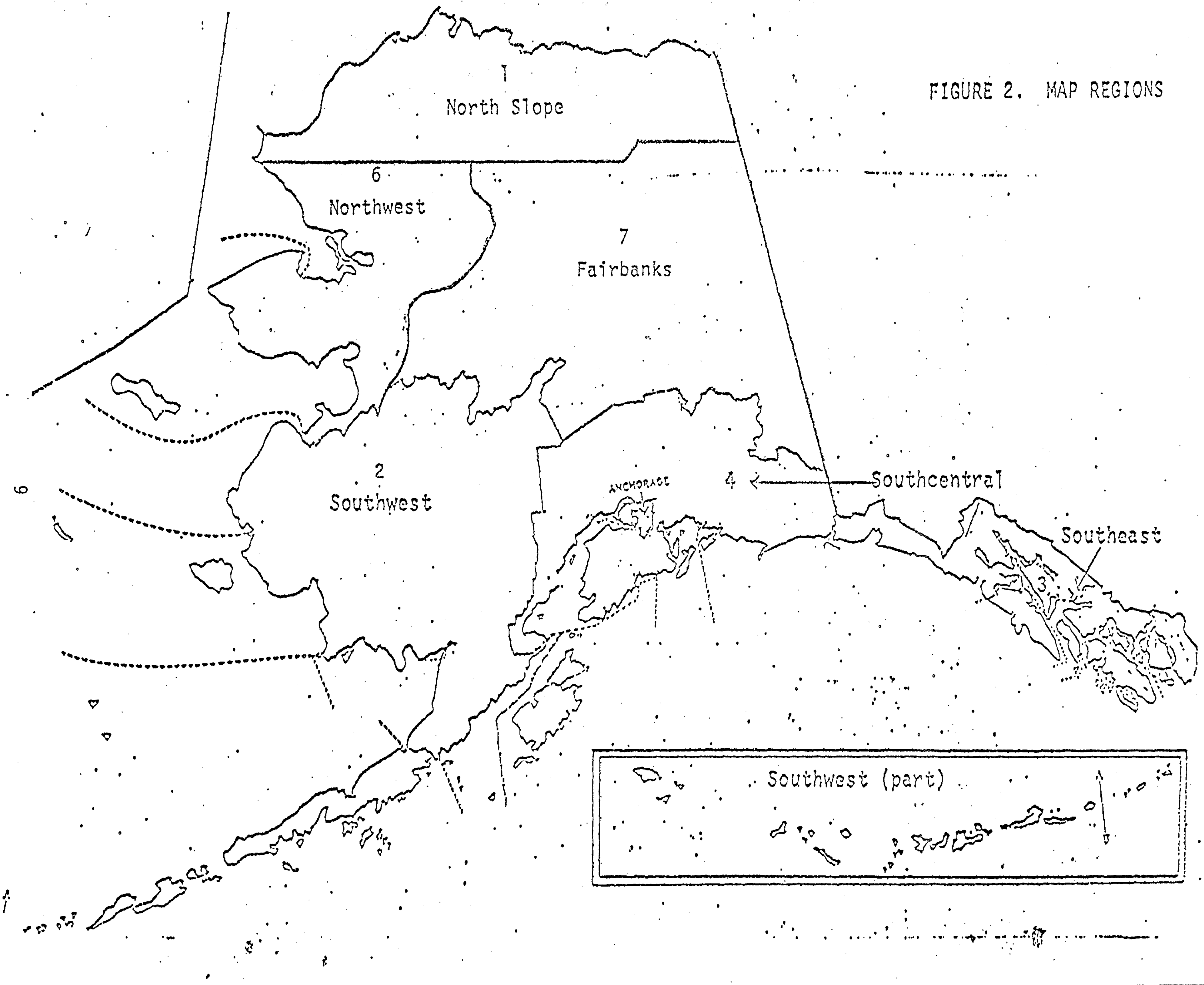
Population is determined based upon a projection of each of its components--births, deaths, and migration. The model uses age-sex-race-specific survival rates and age-race-specific fertility rates to project births and deaths of the civilian population. Total civilian population is found by adding civilian net migration to the natural increase. Net migration is determined by the relative economic opportunities in Alaska. In the model, these are described by employment changes and the Alaskan real per capita income relative to the real per capita income of the United States. An exogenous estimate of military population is added to determine total population.

The fiscal model, which provides important pieces of information for the economic model, also provides a framework for analyzing the effects of alternate fiscal policies. The fiscal model calculates personal tax payments in order to derive disposable personal income. The fiscal model, based on an assumed state spending rule, also calculates personnel expenditures, state government employment, and the amount spent on capital improvements which determines a portion of employment in the construction industry. All three submodels are linked through their requirement for information produced by the other submodels.

The Regional Model

The regional model provides an allocation of employment, income, and population in the state to seven regions of the state. These regions are shown in Figure 2. The economic component is similar in each region to that of the state model. The major difference is that some regional economies are influenced by economic activity in other regions; the most notable of these is Anchorage. The demographic component of the regional model is much simpler than that component of the state model. Regional population is estimated as a function of employment. Regional population is estimated in two components--enclave and nonenclave population. A weighted average of the nonenclave population to nonenclave employment ratio for the state and the lagged value in the region is multiplied by the nonenclave employment to estimate nonenclave population in the current year. The weights are based on the proportion of state population in the region. Enclave employment is added to nonenclave to determine total regional population. Enclave employment includes the military and

FIGURE 2. MAP REGIONS



major construction projects such as the trans-Alaska pipeline. Estimates of the regional model are constrained to total to equivalent state model results.

USE OF THE MODELS FOR IMPACT ASSESSMENT

In order to properly assess the impact of proposed federal OCS development, a plausible range of OCS development scenarios should be used to produce a set of contingent forecasts, each of which should then be compared to a plausible range of corresponding base case forecasts, to bracket a range of potential impacts. However, insofar as such an approach leads to a proliferation of cases which planners are seldom prepared to evaluate, an alternative approach is utilized. Each of a range of plausible OCS development scenarios serves as the basis for a set of forecasts, each to be compared to a single mid-range base case forecast. This gives a single impact for each development scenario, rather than the range of impacts which would be preferable in principle. Then, by varying the key base case assumptions, the sensitivity of this measure to those assumptions is tested to gauge the reliability of the measured impact.

LIMITATIONS OF THE PROPOSED METHODOLOGY

The methodology suggested above is designed to extract a maximum amount of information from historical data using accepted econometric techniques. As such, it can reasonably be expected to reduce the uncertainty associated with the impacts of the proposed developments. However, to suggest that it can completely eliminate such uncertainty or in some cases even significantly reduce it may be to exaggerate the capabilities of the technique, the information contained in historical data, or both. For example, no such model can possibly capture radical structural change, and any such model is limited by the quality and reliability of the data used in its specification and estimation.

At the state level, the major sources of uncertainty which place limitations on such a method are twofold: first, there is a great deal of speculation built into the development of a base case scenario, as will be seen below; and second, the state policy response to the OCS development is both unpredictable and a potentially major determinant of the impact of such development. On the other hand, a reasonably sized data base such as that used in the estimation of the state model can be expected to result in accurate contingent forecasts; and in those cases where measured impacts prove insensitive to base case assumptions, to reliable uncontingent impact measures.

The regional results are subject to far greater limitations and possess far fewer strengths for several reasons. First, the available data is far sparser than on a statewide basis, and the potential specifications are far more complex. As a consequence, estimated relationships in the regional model are less reliable than their statewide counterparts. Furthermore, especially in remote regions such as those analyzed here, the susceptibility of the region to major structural change as a consequence of OCS development is far greater than that encountered at a statewide level. As a consequence, while the techniques proposed here extract the maximum information likely to be gained econometrically, such results necessarily must be interpreted as only a first approximation rather than a detailed analysis of the regional economies. An accurate assessment must incorporate detailed microlevel analysis of such economies. Econometric techniques cannot and should not replace such analysis.

II. HISTORICAL STATEWIDE AND REGIONAL GROWTH PATTERNS: THE BASELINE STUDY

The Alaskan Economy, 1965-1978

The period from 1965 to 1978 witnessed rapid changes in the Alaskan economy, largely induced by the introduction and maturation of the petroleum industry within the state and a changing role of state government in the economy. By 1965, oil and gas developments in the area of Upper Cook Inlet were getting underway, developments which would supply about 2 percent of domestic oil in the United States by the turn of the decade. But far more significantly, the exploration activity also begun in the mid-1960s in the state would, in 1968, yield the largest oil and gas discovery in North America. The Prudhoe Bay discovery, accounting for nearly a fourth of domestic oil reserves, promised to make Alaska a dominant domestic oil supplier by the onset of 1980. The discovery had two major effects, one short-term and one long-term. In the short term, development of the Prudhoe resources required construction of a major pipeline. This construction effort, peaking in 1976, raised employment by 42 percent and income by nearly 75 percent during a span of three years, only to be followed by the most precipitous drop in basic sector employment since statehood, as construction was completed in 1977. The onset of production from Prudhoe in 1977, however, began to reveal the nature of the true long-term significance of oil and gas development in the state. Because of the capital intensive nature of petroleum development, this significance was not to be found in the generation of any substantial long-term direct employment. Rather, the long-term effect would be to alter radically the role of state government in the economy. The

Prudhoe discovery occurred on state-owned lands. Revenues from the initial sale of drilling rights and prospective royalty and production taxes broadly expanded the set of policy options available to state government, placing the Alaskan government in a role unique among the American states in its ability to control its own future development.

This section attempts to map out the major development patterns which have emerged during this period and which promise to shape the course of future economic growth within the state.

DIMENSIONS OF GROWTH

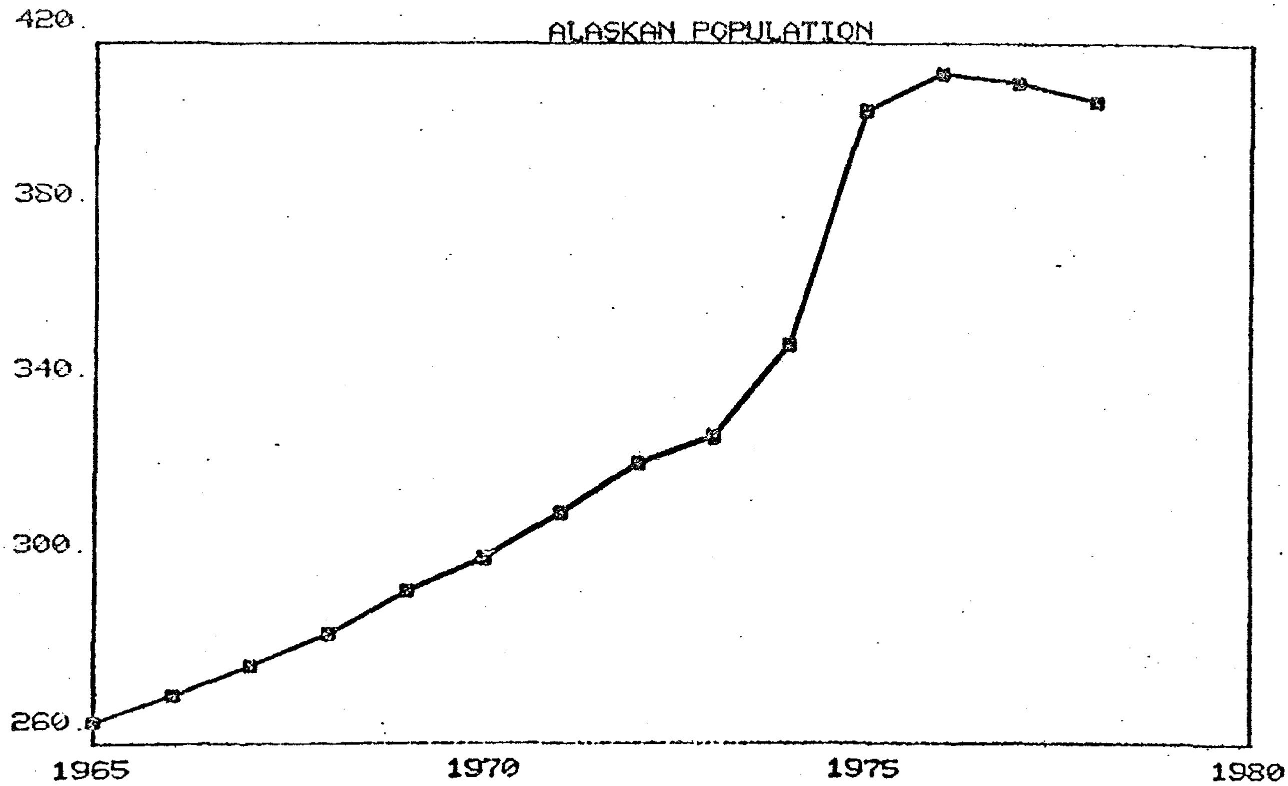
Alaskan Population, 1965-1978

Figure 3 presents the growth of Alaskan population during the period 1965-1978. As is apparent from the figure, there have been three distinct sub-periods in which population growth varied dramatically. From 1965 to 1973, population growth proceeded at a relatively stable rate, averaging 2.8 percent annually. The pipeline buildup from 1973 to 1975 produced an explosion in state population which expanded over 22 percent in the two-year period. As the construction effort peaked in 1976, and fell off abruptly thereafter, population began dropping slightly in 1977 and again in 1978 for an average rate of decline of less than 1 percent annually in the 1976-78 period.

Population growth is composed of two components: natural increase (the excess of births over deaths) and net migration (total in-migration less

FIGURE 3. STATE POPULATION, 1965-1978

(thousands of persons)



1965	265.192
1966	271.505
1967	277.906
1968	284.88
1969	294.56
1970	302.361
1971	312.93
1972	324.281
1973	330.365
1974	351.159
1975	404.634
1976	413.289
1977	411.211
1978	406.956

SOURCE: Alaska Department of Labor

total out-migration). Figure 4 breaks down the changes in Alaskan population since 1965 into its two components.

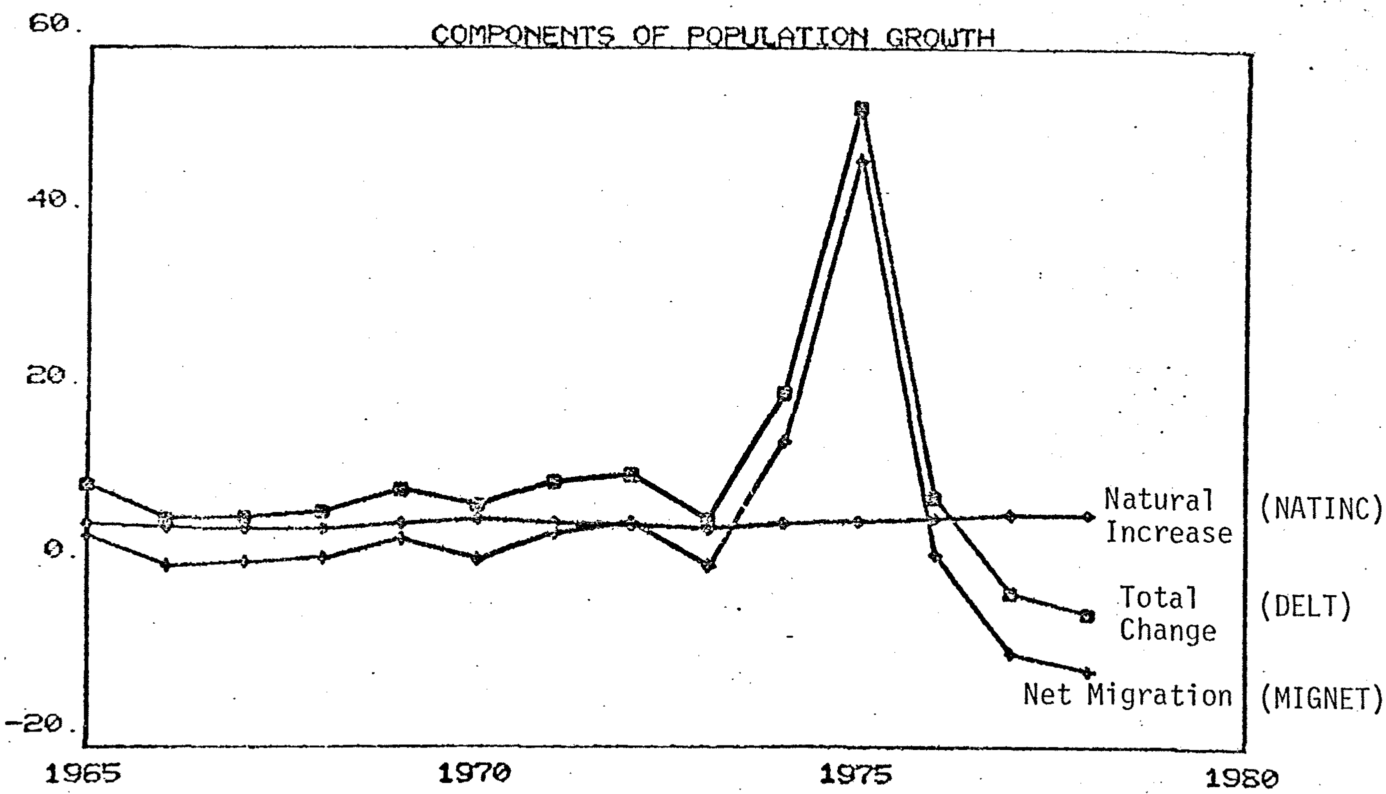
Historically, Alaska has exhibited a rate of natural increase (excess of births over deaths per 1,000 persons) higher than any other state. This reflects both the highest birth rate and the lowest death rate among the states. Both features stem from the youthfulness of the Alaskan population, with the bulk of that population falling into the 14-to-30-year-age brackets, the area of both highest fertility and lowest death rates. Because of the high rate of turnover of the Alaskan population, this somewhat abnormal age distribution has remained fairly stable over time, as shown in Table 1. Natural increase has accounted for slightly under half of total population growth since 1965 and has occurred at a relatively stable rate, growing at an average rate of 1.5 percent annually.

The major source of population growth since 1965, however, has been net migration. While the stability of the age distribution reflects a rapid turnover among the population, on balance there has historically been a tendency for in-migration to more than offset out-migration, as seen in Figure 4. Only the precipitous construction employment drop following completion of the pipeline has been of sufficient magnitude to generate negative net migration (from 1977 to 1978).

Net migration has been found empirically to increase with the rate of employment growth in Alaska and with the differential between Alaskan and U.S. average real per capita incomes. This observation can best

FIGURE 4. COMPOSITION OF STATE POPULATION GROWTH, 1965-1978

(thousands of persons)



	NATINC	DELT	MIGNET
1965	5.662	10.201	4.539
1966	5.273	6.313	1.04
1967	5.026	6.401	1.375
1968	5.098	6.974	1.876
1969	5.613	9.68	4.067
1970	6.127	7.801	1.674
1971	5.857	10.569	4.712
1972	5.479	11.351	5.872
1973	5.147	6.084	0.937
1974	5.609	20.794	15.185
1975	5.948	53.475	47.527
1976	6.295	8.655	2.36
1977	6.772	-2.078	-8.85
1978	6.702	-4.255	-10.957

SOURCE: Alaska Department of Labor

TABLE 1. ALASKA POPULATION
AGE-SEX DISTRIBUTION
1970, 1976

	1970			1976		
Age	Males	Females	Total	Males	Females	Total
All Ages	54.2	45.7		51.6	48.4	
0-13	16.5	15.7	32.2	14.1	13.2	27.3
14-19	5.7	5.2	10.9	6.6	6.0	12.6
20-29	12.4	8.7	21.1	11.2	10.4	21.6
30-39	7.7	6.5	14.2	7.8	7.8	15.6
40-54	8.1	6.6	14.7	7.7	7.2	14.9
55-64	2.5	2.0	4.5	3.1	2.6	5.7
65 +	1.3	1.0	2.3	1.1	1.2	2.3

SOURCES: U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population.

U.S. Department of Commerce, Bureau of the Census, 1976 Survey of Income and Education Microdata Tape.

be understood by viewing the migration decision as a choice made by an individual in the face of uncertainty. The probability that any individual will choose to move will depend on the expected gain to be realized by such a move. As the expected gain rises, the individual becomes more likely to migrate. The expected gain from a move is simply the product of the wage differential to be realized as a consequence of the move and the probability of actually securing employment at that higher wage. Thus, either a change in the rate of employment growth in Alaska (by increasing the probability of being hired) or an increase in the absolute income differential between Alaska and the United States will, by raising the expected gain from in-migration, attract increasing numbers of new migrants to the state.

Unlike natural increase, however, migration into Alaska has created a great deal of volatility in the dynamics of statewide population growth. Net migration reached over +47,000 in 1975 and as low as nearly -9,000 in 1977. Of the total contribution of nearly 78,000 made by net migration to population growth over the period, over 72 percent occurred since 1973.

This volatility of population can create major strains on local infrastructure when the growth occurs at too rapid a rate for adjustment. Such strains produce adverse effects on prices and unemployment, as will be discussed below. Further, it creates a somewhat characteristic Alaskan policy problem--namely that state policies aimed at the promotion of growth objectives may be doomed to failure by their own success. That is, any policy producing substantial, rapid growth in the Alaskan economy may also, by its attraction of temporary migrants, have benefits which flow disproportionately to non-Alaskans. Thus, a major concern over growth-oriented policies must be the sustainability of such policies. As will be seen later, this is of particular concern when the state's major wealth is a depletable resource.

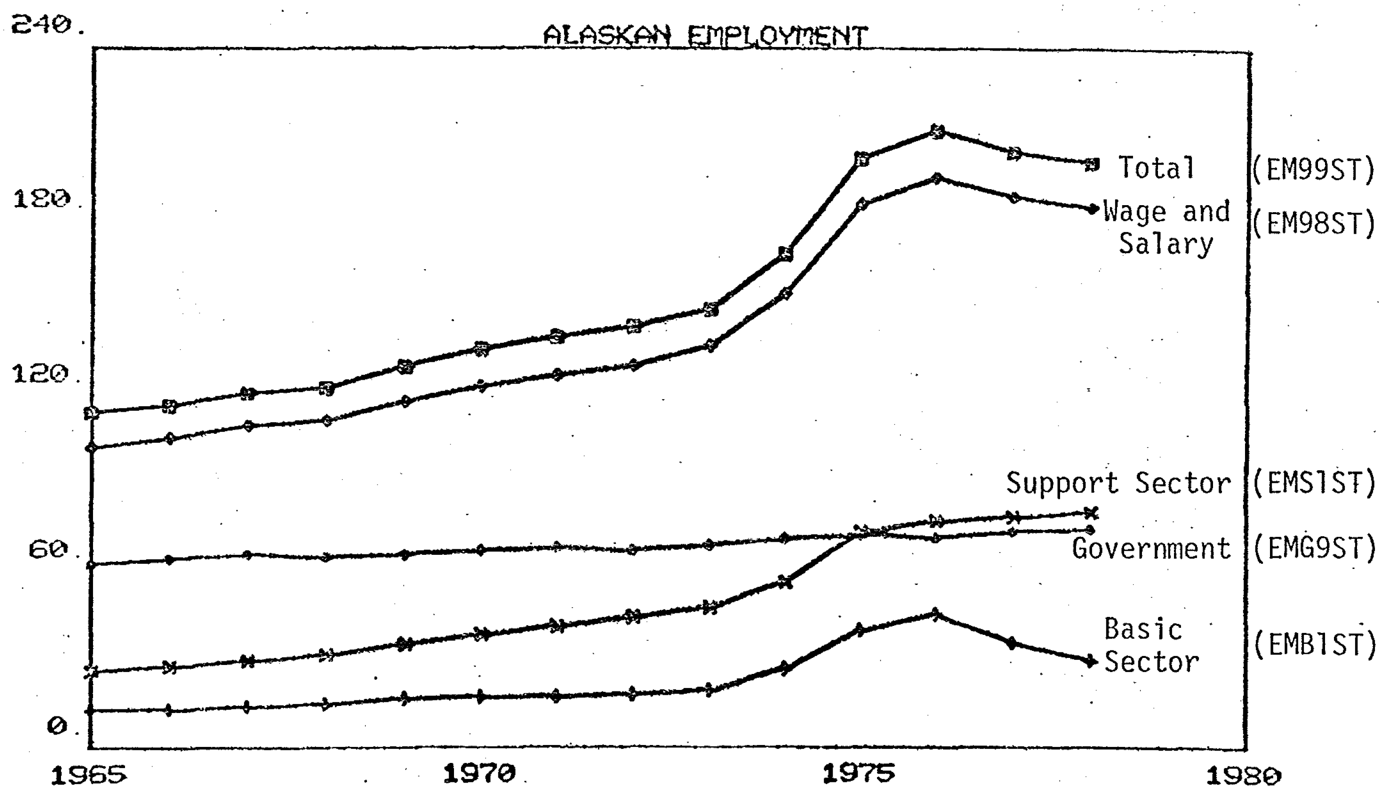
Alaskan Employment, 1965-1978

Figure 5 presents the growth of Alaskan employment during the period 1965 to 1978. As in the case of population growth, three distinct sub-periods are clearly discernible. In the pre-pipeline period from 1965 to 1973, employment grew steadily at an average rate of 3.6 percent. During the buildup and construction of the pipeline between 1973 and 1976, total employment expanded over 42 percent, an annual average rate of over 12.5 percent. After the 1976 peak, total employment fell off, but much less radically than the decline in construction employment. While 1978 construction employment dropped by nearly 60 percent from its 1976 peak, total employment fell by less than 4 percent.

Total wage and salary employment in the state can be divided into three major categories: government, basic employment, and support sectors. Basic employment will be defined as those private sectors in which production is aimed primarily at the satisfaction of export demands. In Alaska, such sectors include agriculture, forestry, and fisheries; mining (primarily petroleum); construction; and manufacturing. Support sector employment is engaged in activity aimed primarily at the satisfaction of local demands and includes utilities, transportation, communications, trade, finance, and services.

FIGURE 5. STATEWIDE EMPLOYMENT, 1965-1978

(thousands of persons)



	EM99ST	EM98ST	EMS1ST	EMG9ST	EMB1ST
1965	115.143	103.543	26.901	62.68	13.962
1966	117.601	106.401	28.26	64.105	14.036
1967	121.667	110.467	30.244	65.49	14.733
1968	123.629	112.429	32.102	64.804	15.523
1969	130.817	118.917	35.891	65.68	17.346
1970	136.397	123.897	38.998	66.978	17.921
1971	140.671	127.671	41.76	68.029	17.882
1972	144.096	130.696	44.847	66.948	18.901
1973	150.308	137.308	48.165	68.951	20.192
1974	169.652	155.652	56.74	71.224	27.688
1975	201.84	186.649	73.867	72.479	40.303
1976	211.412	195.561	78.107	71.816	45.638
1977	204.127	189.106	79.237	73.779	36.09
1978	200.49	185.84	81.011	74.756	30.073

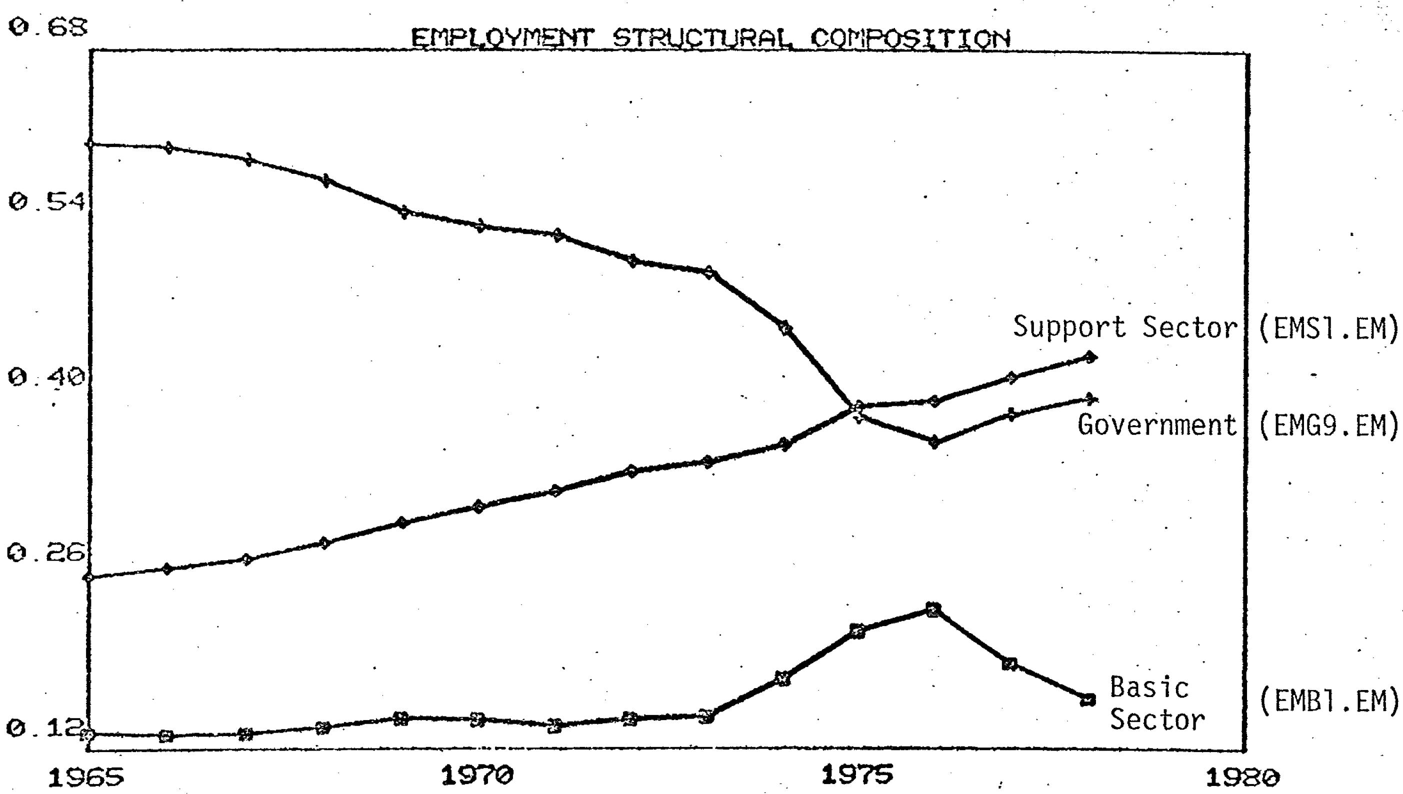
SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

One of the most significant historical trends identifiable from the data is the changing role of government in the Alaskan economy. As shown in Figure 6, the share of government employment in total Alaskan wage and salary employment has fallen from over 60 percent in 1965 to about 40 percent in 1978. In addition, there has been a fairly dramatic shift in the composition of such employment. Historically, federal employment has been the mainstay of the Alaskan economy. In 1965, nearly 49 percent of Alaskan employment consisted of federal employees, over 65 percent of whom were military. By 1978, the federal share of employment was more than cut in half, and the military share of that employment had fallen to 52 percent. Nonetheless, total government employment in Alaska has risen, due to a steadily growing state and local government sector which has more than offset the declining military presence in Alaska. As seen in Figure 7, by 1969 state and local employment had exceeded federal civilian employment. By 1975, it exceeded military employment; and by 1978, it had reached a level approaching 84 percent of total federal employment.

Basic employment in Alaska consists primarily of construction and manufacturing (primarily food processing) employment, as shown in Figure 8. Pipeline construction caused employment in the Alaskan construction industry to nearly quadruple between 1973 and 1976. Interestingly, however, despite the 60 percent drop by 1978 from the 1976 peak, 1978 construction employment remained over 64 percent higher than its 1973 level. In addition, development and production employment at Prudhoe Bay, North Slope exploration, oil industry administration employment in

FIGURE 6. COMPOSITION OF STATEWIDE EMPLOYMENT, 1965-1978

(proportion of total employment)

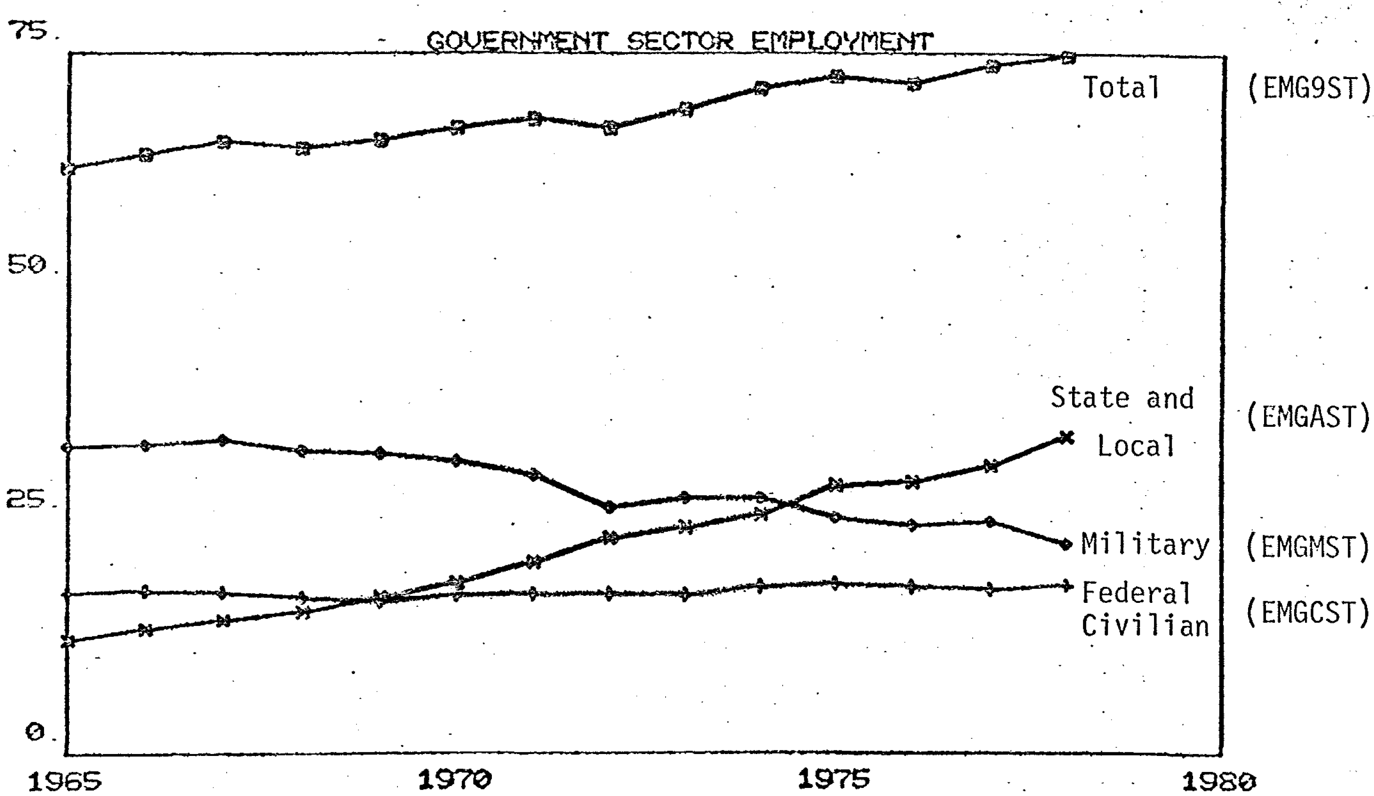


	EMS1.EM	EMG9.EM	EMB1.EM
1965	0.26	0.605	0.135
1966	0.266	0.602	0.132
1967	0.274	0.593	0.133
1968	0.286	0.576	0.138
1969	0.302	0.552	0.146
1970	0.315	0.541	0.145
1971	0.327	0.533	0.14
1972	0.343	0.512	0.145
1973	0.351	0.502	0.147
1974	0.365	0.458	0.178
1975	0.396	0.388	0.216
1976	0.399	0.367	0.233
1977	0.419	0.39	0.191
1978	0.436	0.402	0.162

SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

FIGURE 7. COMPOSITION OF GOVERNMENT EMPLOYMENT, 1965-1978

(thousands of persons)

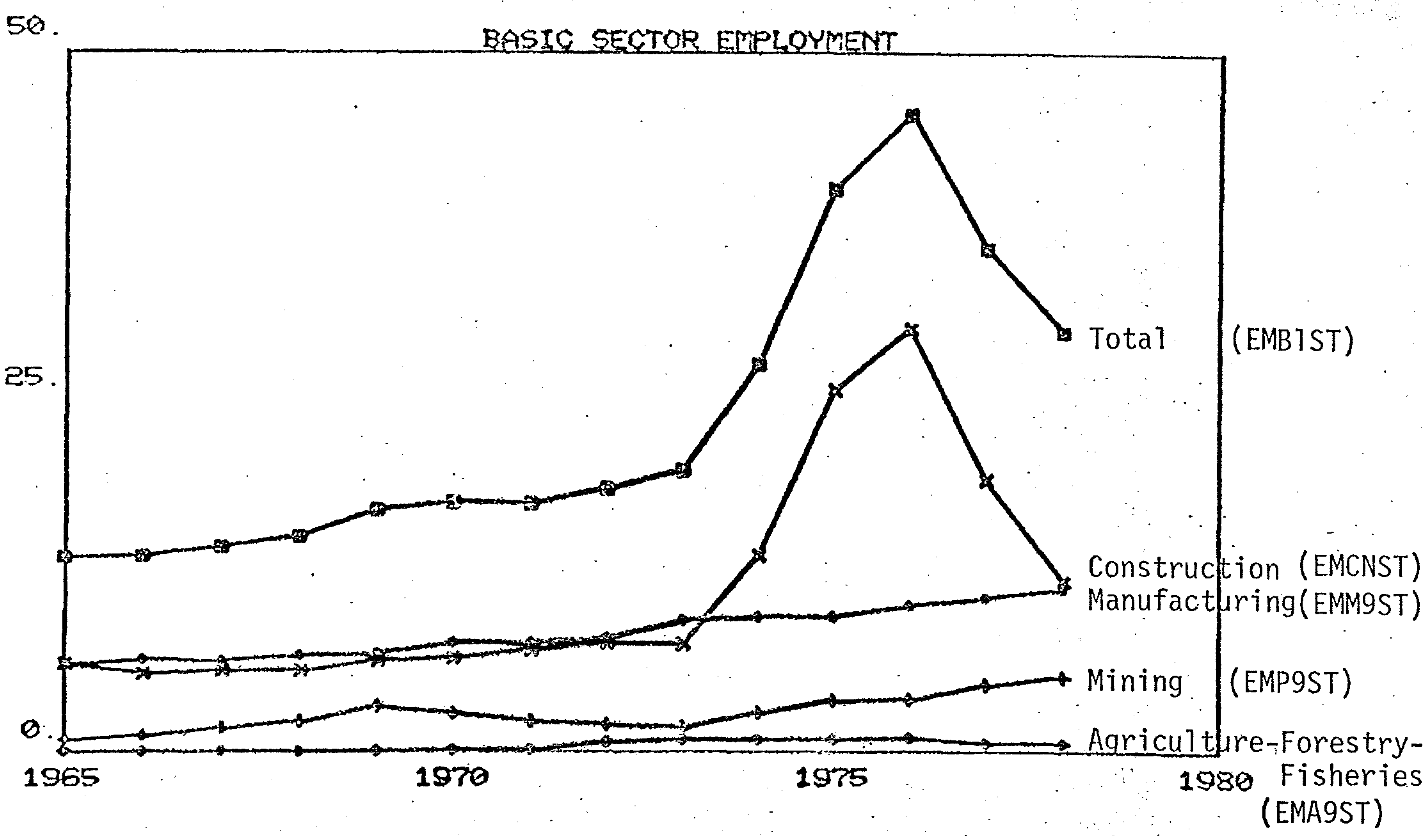


	EMG9ST	EMGAST	EMGMST	EMGCST
1965	62.68	12.234	33.017	17.429
1966	64.105	13.396	33.2	17.509
1967	65.49	14.389	33.679	17.422
1968	64.804	15.324	32.62	16.86
1969	65.68	16.877	32.35	16.453
1970	66.978	18.441	31.425	17.112
1971	68.029	20.686	30.074	17.269
1972	66.948	23.264	26.45	17.234
1973	68.951	24.332	27.453	17.166
1974	71.224	25.755	27.453	18.016
1975	72.479	28.837	25.348	18.294
1976	71.816	29.334	24.539	17.943
1977	73.779	31.061	24.984	17.734
1978	74.756	34.122	22.501	18.133

SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

FIGURE 8. COMPOSITION OF BASIC SECTOR EMPLOYMENT, 1965-1978

(thousands of persons)



	EMB1ST	EMCNST	EMM9ST	EMP9ST	EMA9ST
1965	13.962	6.455	6.274	1.088	0.145
1966	14.036	5.864	6.634	1.372	0.166
1967	14.733	5.991	6.621	1.967	0.154
1968	15.523	5.998	6.924	2.455	0.146
1969	17.346	6.653	7.025	3.494	0.174
1970	17.921	6.894	7.839	2.995	0.193
1971	17.882	7.445	7.78	2.431	0.226
1972	18.901	7.893	8.06	2.113	0.835
1973	20.192	7.837	9.349	1.966	1.04
1974	27.688	14.068	9.612	2.977	1.031
1975	40.303	25.88	9.639	3.795	0.989
1976	45.638	30.235	10.334	3.967	1.102
1977	36.09	19.546	10.895	4.958	0.691
1978	30.073	12.24	11.595	5.562	0.676

SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

Anchorage, and a vigorous growth in manufacturing have at least partially offset the decline in basic sector employment during the post-pipeline period.

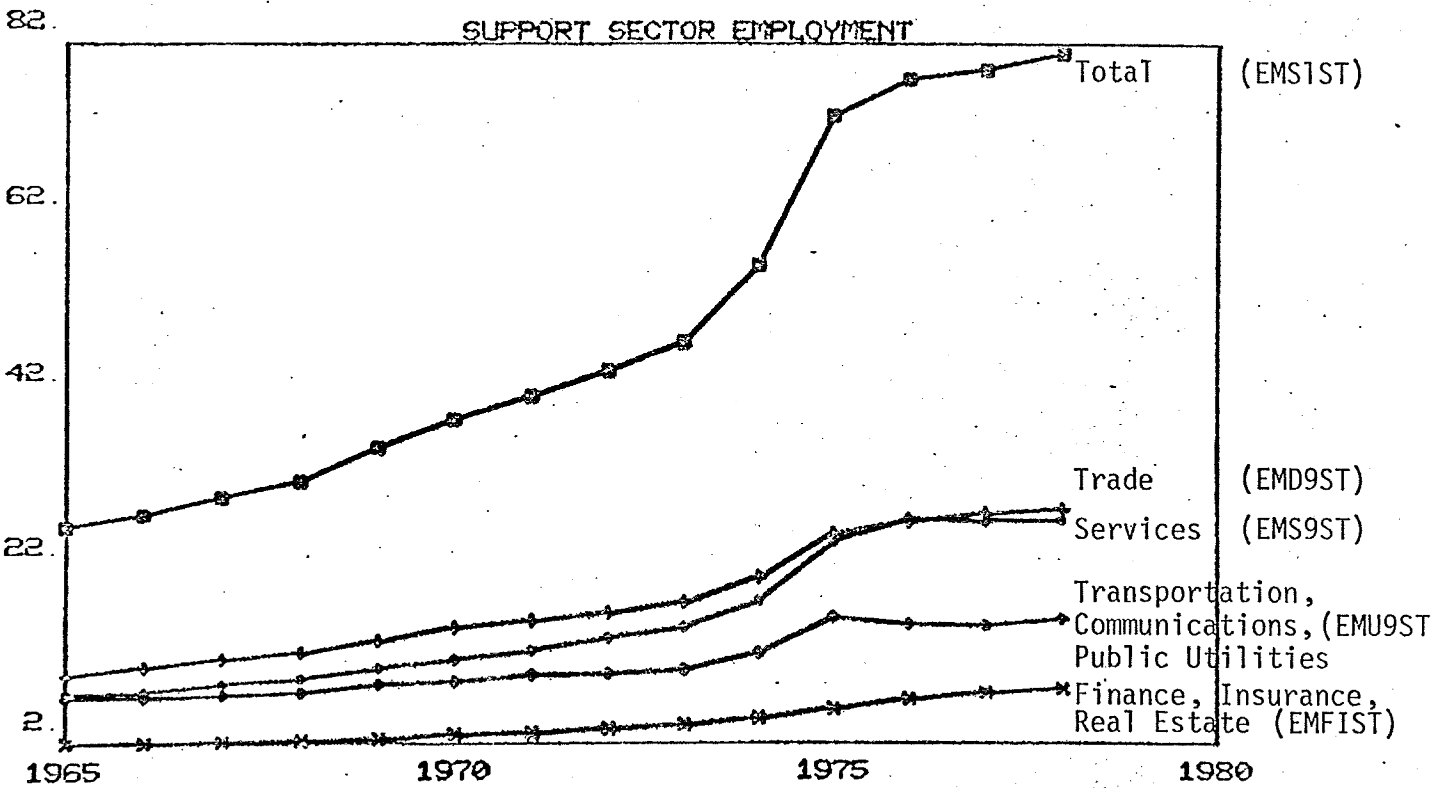
Growth in the Alaskan support sector since 1965 is shown in Figure 9. In the stable growth period before the pipeline (1965-1973), the support sector grew at well over twice the rate (7.6 percent) of total employment (3.6 percent). Services employment led this growth, at a rate of 9.1 percent. Finance and trade followed closely behind (8.7 percent and 7.9 percent, respectively), while transportation, communications, and public utilities grew at only 4.6 percent annually. Services employment responded most vigorously to pipeline construction, growing over 37 percent between 1974 and 1975. As a whole, the support sector expanded by over 62 percent between 1973 and the peak of pipeline construction. Interestingly, however, employment in the support sector did not decline with completion of the pipeline, but rather has continued to grow, although at a rate (3.7 percent) below that of the pre-pipeline period (4.6 percent).

Alaskan Personal Income

Alaskan personal income growth, as employment and population, can be divided into the same three subperiods. As shown in Figure 10, in the pre-pipeline years from 1965 to 1974, income grew steadily, averaging about 12.3 percent annually. Accompanied by inflation and population growth, however, this represented only about a 4.4 percent average annual growth in real per capita income, as shown in Figure 11. From 1974 to the peak of pipeline construction in 1976, income rose by

FIGURE 9. COMPOSITION OF SUPPORT SECTOR EMPLOYMENT, 1965-1978

(thousands of persons)

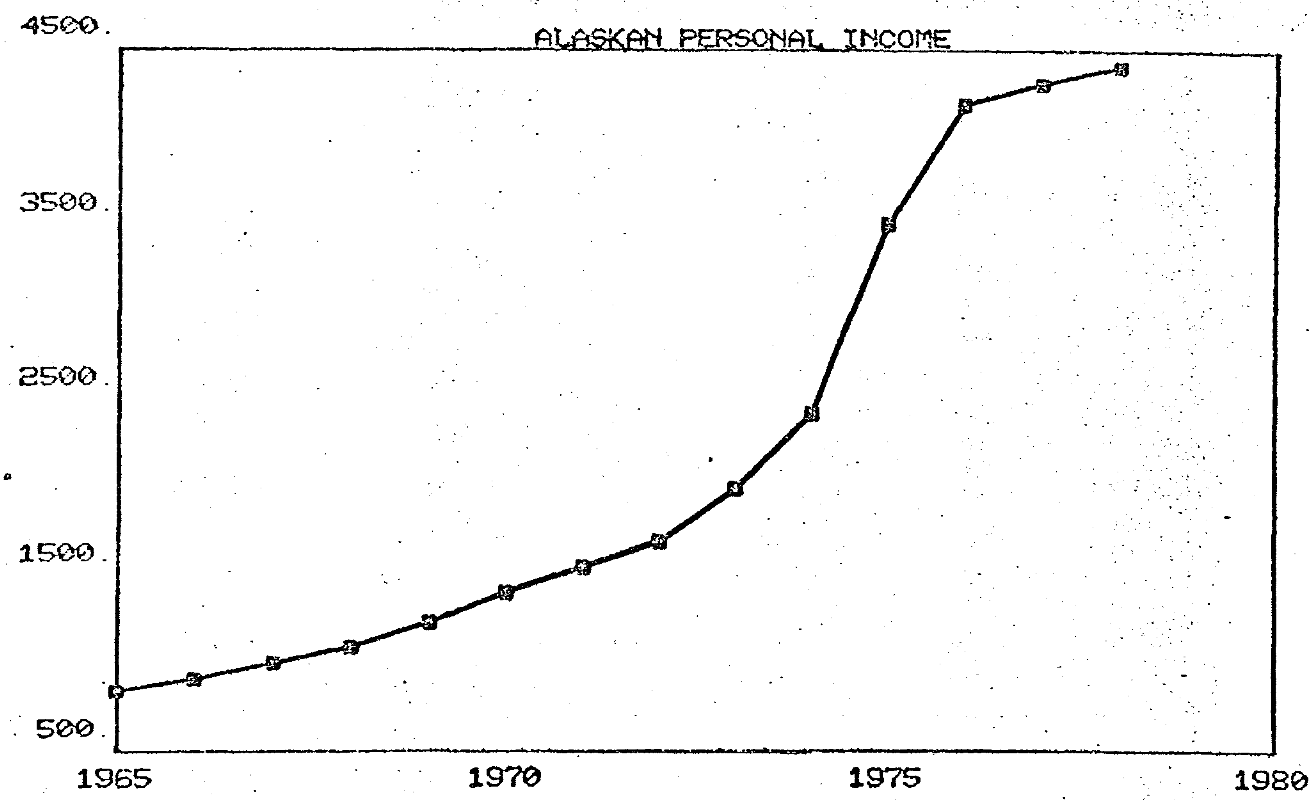


	EMS1ST	EMD9ST	EMS9ST	EMU9ST	EMFIST
1965	26.901	9.95	7.513	7.267	2.171
1966	28.26	10.806	7.89	7.279	2.285
1967	30.244	11.754	8.692	7.483	2.315
1968	32.102	12.519	9.289	7.811	2.483
1969	35.891	13.946	10.486	8.807	2.652
1970	38.998	15.365	11.435	9.1	3.098
1971	41.76	16.148	12.559	9.808	3.245
1972	44.847	17.107	14.034	9.993	3.713
1973	48.165	18.337	15.182	10.403	4.243
1974	56.74	21.135	18.313	12.398	4.894
1975	73.867	26.198	25.134	16.489	6.046
1976	78.107	27.569	27.673	15.76	7.105
1977	79.237	28.453	27.441	15.569	7.774
1978	81.011	28.848	27.566	16.369	8.228

SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

FIGURE 10. STATEWIDE PERSONAL INCOME, 1965-1978

(millions of current dollars)

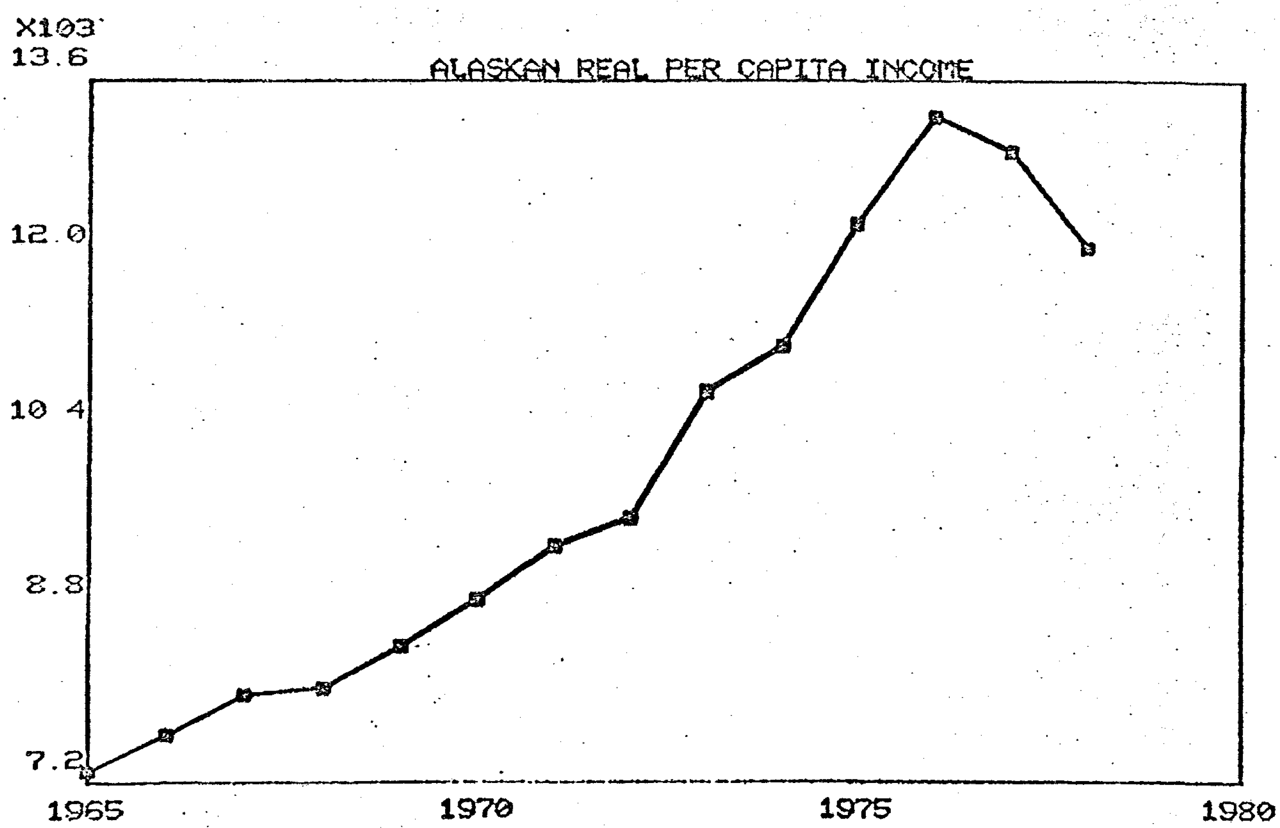


1965	857.
1966	926.
1967	1016.
1968	1110.
1969	1245.
1970	1412.
1971	1557.
1972	1698.
1973	2002.
1974	2437.
1975	3528.
1976	4195.
1977	4315.
1978	4415.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, August 1979.

FIGURE 11. REAL PER CAPITA INCOME, 1965-1978

(thousands of 1979 dollars)



1965	7317.63
1966	7650.87
1967	8016.97
1968	8084.73
1969	8455.59
1970	8881.79
1971	9371.82
1972	9630.57
1973	10783.9
1974	11198.6
1975	12321.3
1976	13278.1
1977	12959.2
1978	12105.9

SOURCE: Alaska Department of Labor and U.S. Department of Commerce, Bureau of Economic Analysis.

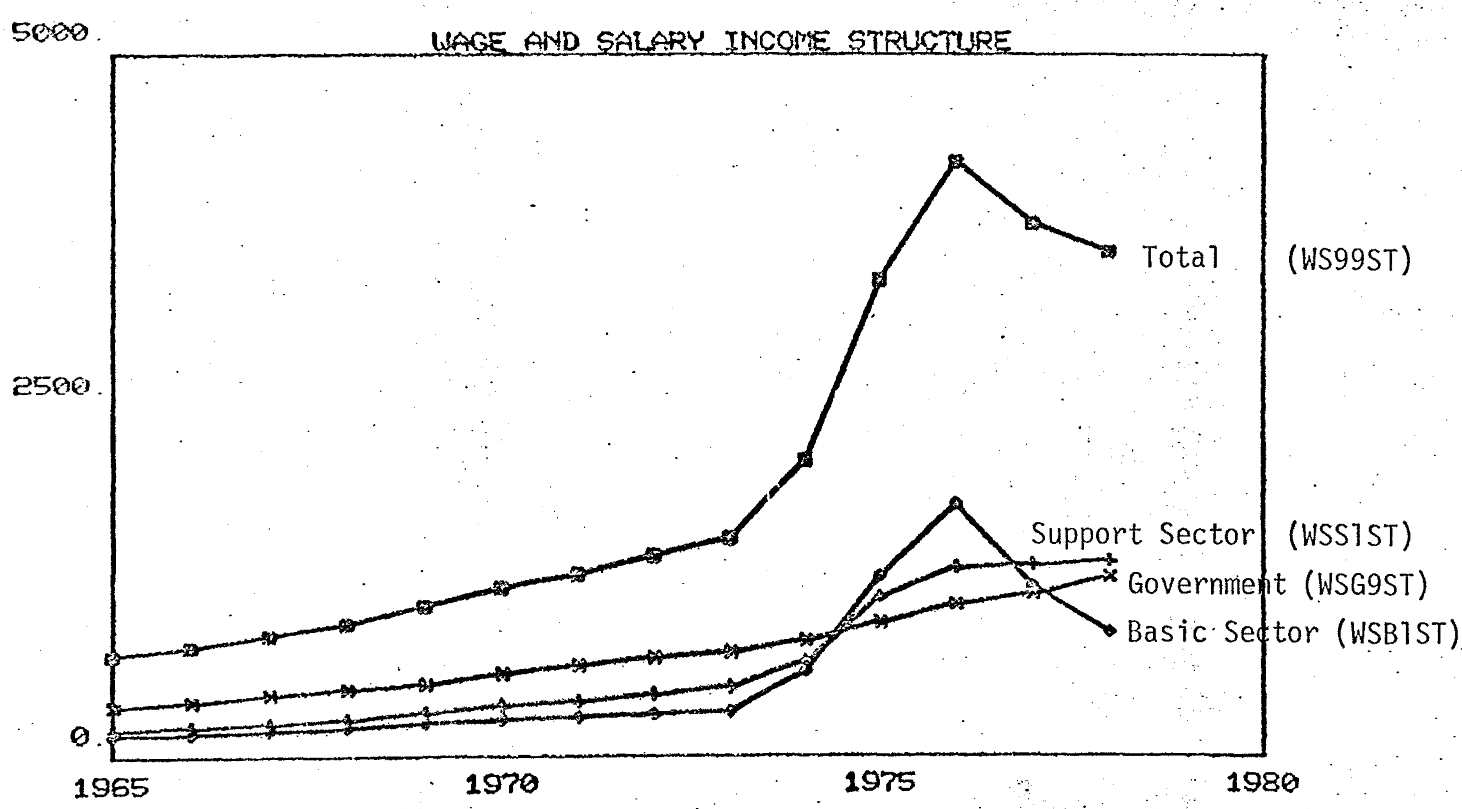
72 percent in nominal terms and 46 percent in real per capita terms. After the peak of pipeline construction, between 1976 and 1978, personal income continued to rise modestly, about 2.6 percent annually. However, these gains were more than offset by inflation and population, with real per capita incomes falling about 5.6 percent annually after the 1976 peak.

These figures, however, do not capture the full magnitude of the pipeline and post-pipeline experience, inasmuch as they are adjusted by the Bureau of Economic Analysis to reflect the incomes of resident Alaskans only. A substantial share of income during pipeline construction was earned by nonresidents. As shown in Figure 12, the growth of wages and salary payments grew roughly parallel to personal income in the 1965-to-1974 period. (More precisely, personal income growth followed wage and salary growth, inasmuch as such payments are the major component of personal income--between 80 and 90 percent, historically). Because of wages and salaries earned by nonresidents, the growth of wages and salaries during pipeline construction was more dramatic than resident personal income growth, with wages and salaries more than doubling between 1974 and 1976. Furthermore, unlike resident personal income, which continued to rise modestly even after the peak of pipeline construction, wage and salary payments actually declined by 16 percent in the 1976-to-1978 period.

Because wages and salaries dominate the personal income received by Alaskans, the sources of such payments reveal the underlying structure of income growth during the period, as shown in Figure 12. Wages and

FIGURE 12. COMPOSITION OF WAGES AND SALARIES
1965-1978

(millions of current dollars)



	WS99ST	WSS1ST	WSG9ST	WSB1ST
1965	722.3	201.645	363.507	157.15
1966	777.285	218.22	395.005	164.06
1967	867.176	243.033	442.88	181.264
1968	947.335	269.04	475.023	203.273
1969	1080.86	319.055	516.293	245.515
1970	1217.74	359.985	593.559	264.195
1971	1315.2	392.598	646.625	275.974
1972	1447.06	444.356	708.574	294.135
1973	1564.03	496.207	747.916	319.905
1974	2106.06	673.77	830.269	602.024
1975	3402.94	1152.82	960.558	1289.56
1976	4247.18	1362.48	1089.32	1795.37
1977	3804.95	1380.42	1166.39	1226.2
1978	3606.58	1404.49	1291.58	881.358

SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

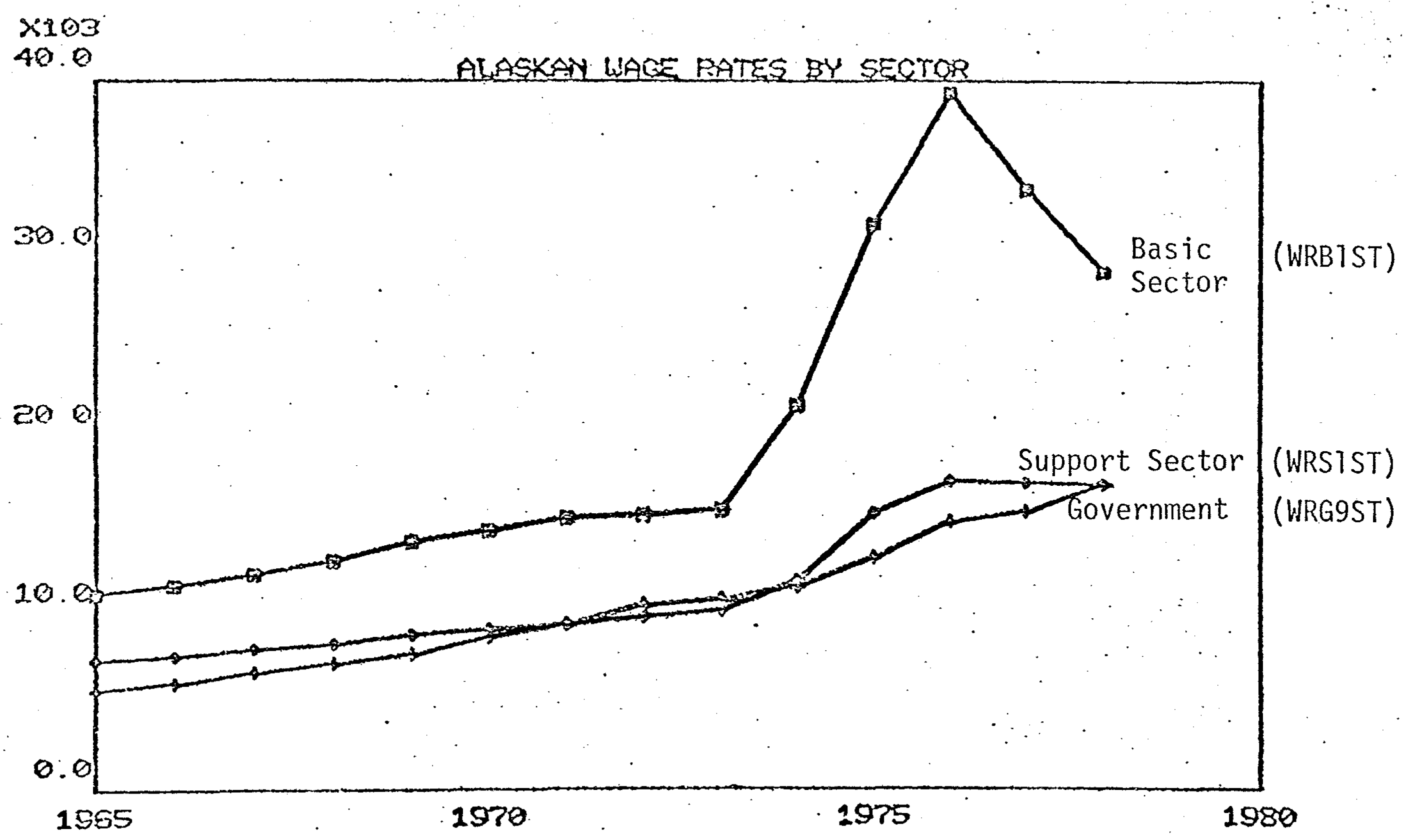
salaries were composed primarily of government wages (50.3 percent) in 1965. By 1978, the government share had fallen to 36 percent, although generally government wages and salaries grew steadily throughout the period at about 10 percent annually. The income "explosion" in 1975 and 1976 was due primarily to wage and salary payments in construction and to a lesser extent in the support sector, primarily transportation. However, the "explosion" was due as much to an increase in wage rates as to increased employment. Between 1974 and 1976, basic sector employment rose 65 percent, while wages and salaries in the basic sector nearly tripled, due to a more than 80 percent increase in average wage rates in the sector, as shown in Figure 13. In the support sector, wages and salaries more than doubled in the two-year period, reflecting a 38 percent rise in employment and a 47 percent increase in wage rates. However, while both basic employment and wage rates dropped in the period following the peak of pipeline construction, causing over a 50 percent decline in basic sector wages and salaries, neither employment nor wage rates in the support sector fell significantly during the 1976-to-1978 period. Thus, by 1978, the support sector had become the dominant source of both income (39 percent of wages and salaries) and employment (49.5 percent) in the Alaskan economy.

Special Features

The Alaskan economy exhibits several major characteristics unique among the states. We now turn to consider each of the four major distinguishing characteristics of the Alaskan economy: its typically high unemployment levels, the seasonality of employment, its price level, and the unique role of state government.

FIGURE 13. ALASKAN WAGE RATES, 1965-1978

(thousands of current dollars)

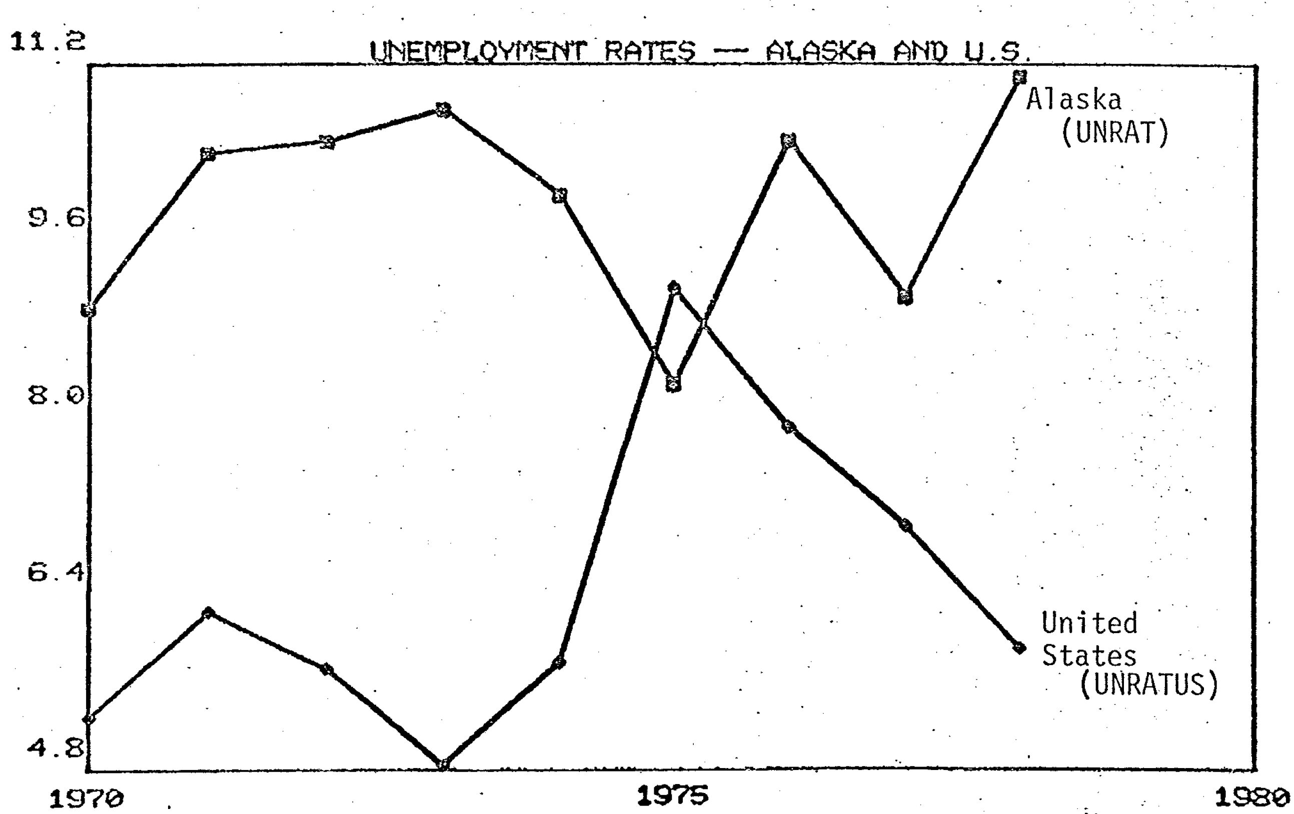


	WRB1ST	WRS1ST	WRG9ST
1965	11255.5	7495.82	5799.41
1966	11688.5	7721.87	6161.85
1967	12303.2	8035.74	6762.56
1968	13094.9	8380.78	7330.15
1969	14154.	8889.56	7860.73
1970	14742.2	9230.87	8862.
1971	15433.1	9401.29	9505.13
1972	15561.9	9908.26	10583.9
1973	15843.1	10302.2	10847.1
1974	21743.2	11874.7	11657.2
1975	31996.6	15606.7	13252.9
1976	39339.4	17443.8	15168.3
1977	33976.2	17421.4	15809.2
1978	29307.3	17337.	17277.2

SOURCE: Alaska Department of Labor, Statistical Quarterly, various issues.

Unemployment. Unemployment has traditionally been a serious problem in Alaska. Despite generally vigorous growth since 1975, unemployment rates have remained considerably above the national level, as shown in Figure 14. In only a single year, 1975, did Alaskan unemployment dip below that of the United States. Unemployment rates can be a misleading indicator of economic conditions, however, for the following reason. Defined as the ratio of unemployed persons seeking employment to the total labor force, it may fall due to either of two reasons--an increase in employment or a decrease in search by unemployed workers. In the first case, a decrease in unemployment indicates rising employment levels; but in the second, it may indicate precisely the opposite since it is precisely at times of falling employment when workers get discouraged from searching and leave the labor force (by definition). For example, as shown in Figure 15, generally unemployment rates move opposite the direction of employment growth, as would be expected. However, on occasion such as in 1977, the year following the peak of pipeline construction, the unemployment rate fell despite falling employment. The reason for the apparent anomaly is made clear by the labor force participation rate behavior, also depicted. In 1977, labor force participation fell drastically, by about 20 percent, sufficient to reduce the unemployment rate despite a falling employment level. Nonetheless, despite its peculiarities in use as an economic indicator, its high level does illustrate a unique Alaskan dilemma. Even at the peak of pipeline hiring, Alaskan unemployment dipped only slightly below the national rate, and then only because the national economy was in the depths of a particularly severe recession. By 1976, at the peak of

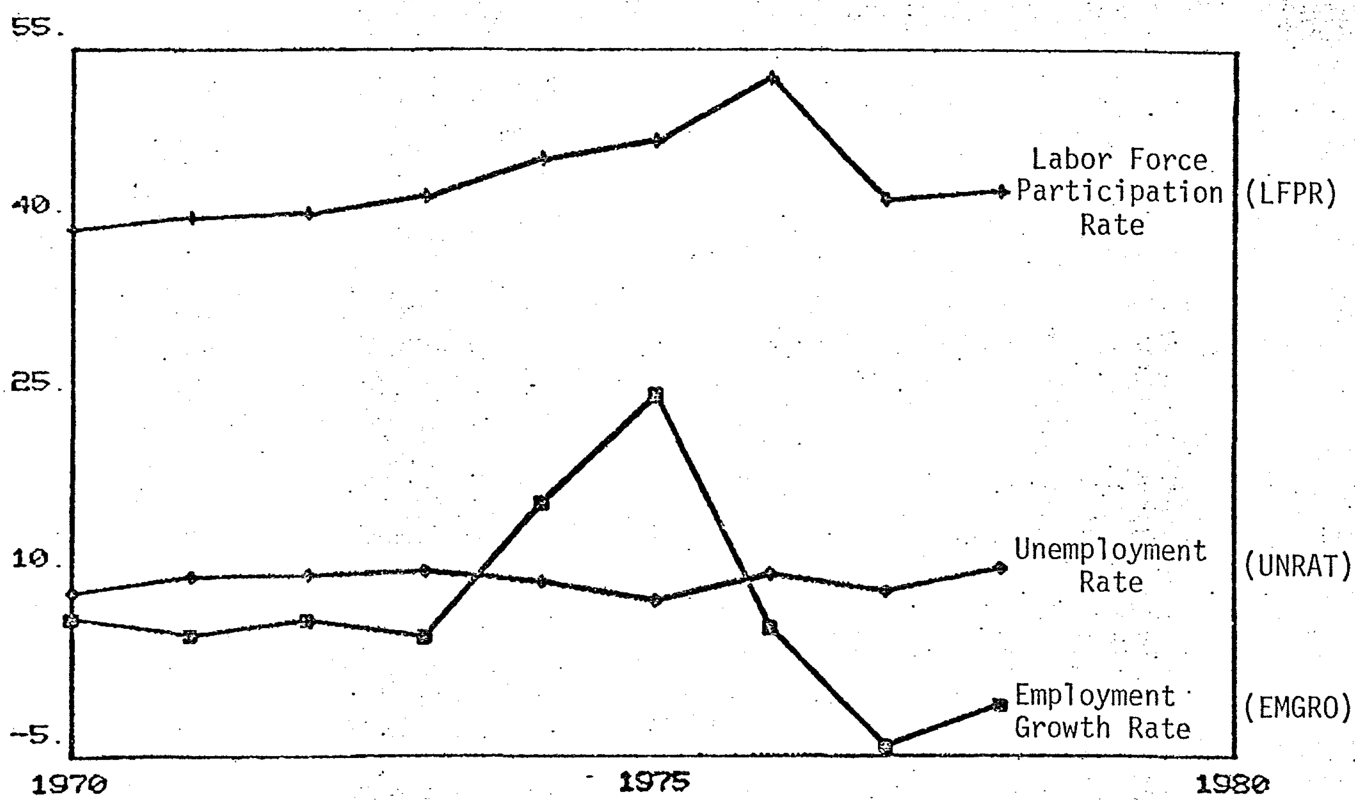
FIGURE 14. ALASKAN AND U.S. UNEMPLOYMENT, 1970-1978



	UNRAT	UNRATUS
1970	9.	5.283
1971	10.4	6.242
1972	10.5	5.717
1973	10.8	4.842
1974	10.	5.758
1975	8.3	9.175
1976	10.5	7.9
1977	9.1	7.008
1978	11.1	5.892

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, and Alaska Department of Labor.

FIGURE 15. UNEMPLOYMENT, EMPLOYMENT GROWTH, AND LABOR FORCE PARTICIPATION RATES, 1970-1978



	LFPR	UNRAT	EMGRO
1970	39.94	9.	6.821
1971	40.97	10.4	5.542
1972	41.27	10.5	6.813
1973	42.78	10.8	5.381
1974	46.	10.	16.698
1975	47.4	8.3	25.821
1976	52.65	10.5	6.027
1977	42.55	9.1	-4.035
1978	43.23	11.1	-0.477

SOURCE: Alaska Department of Labor.

pipeline construction, unemployment in Alaska had surged to over 10.5 percent. The problem is a fundamental feature of the Alaskan economy which stems largely from the volatility of migration discussed above. As employment rises, the attraction of migrants from the Lower 48 raises the labor force by even more, forcing a rise in the unemployment rate. Furthermore, rising employment has typically resulted in increased labor force participation rates, reducing still further any tendency of employment increases to lower unemployment rates significantly.

Seasonality. A second feature characteristic of Alaskan employment and also closely related to the unusually high Alaskan unemployment rate is the seasonality of employment in certain sectors of the economy. Economies dependent on natural resources often have seasonal cycles, but the effect is particularly accentuated by the severity and length of Alaskan winters. One measure of seasonality is the ratio of fourth-to-third-quarter employment. The closer the index to one, the less seasonal the industry. Table 2 shows the seasonality of Alaskan industries. Seasonality has decreased in importance over time, owing to several factors. First, the shifting structure of the economy toward the support sectors has resulted in increasing concentration in nonseasonal employment such as services and trade. Second, technology became available during the period to permit winter construction activity, and market conditions made it profitable to employ these technologies in Alaska.

TABLE 2. SEASONALITY OF EMPLOYMENT IN ALASKA
SELECTED YEARS, 1950 TO 1978

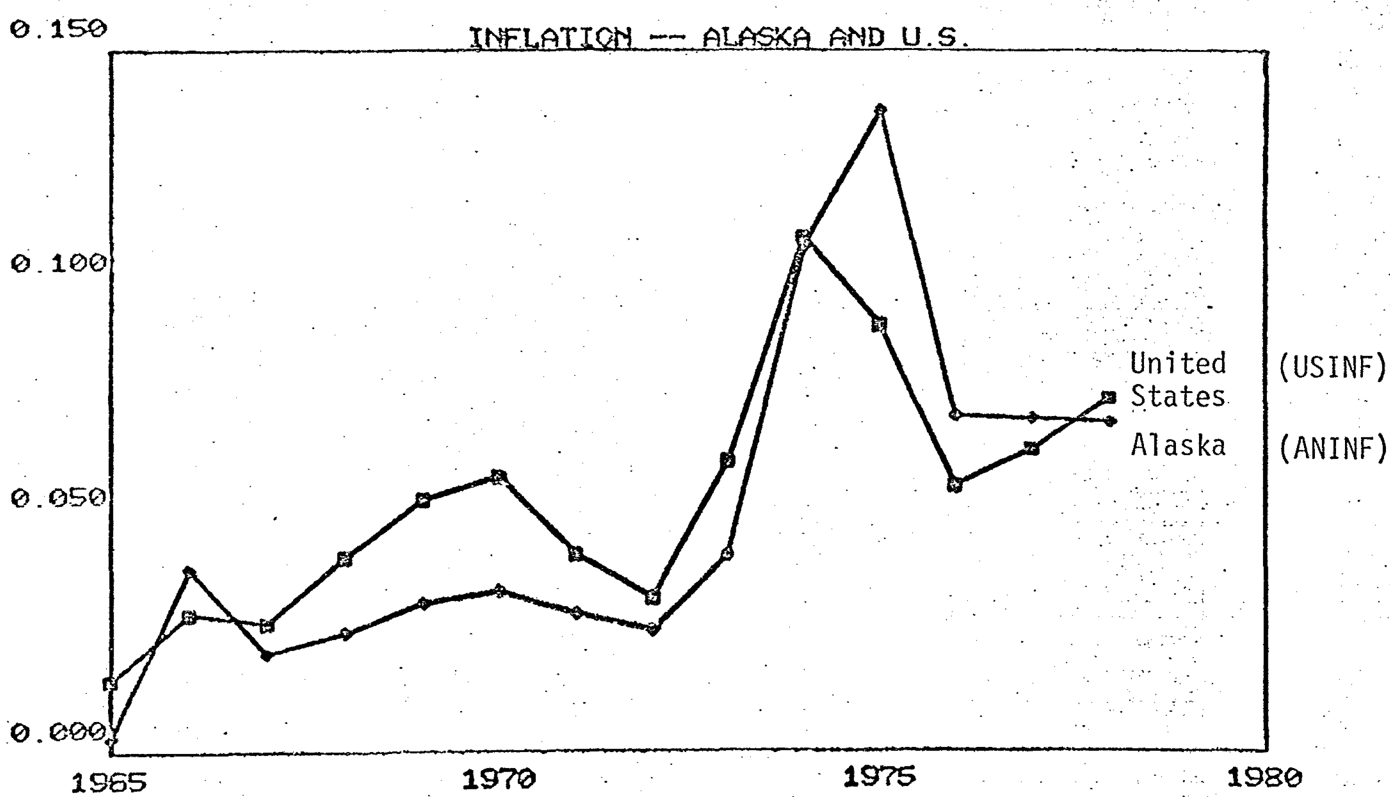
SECTOR	1950	1960	1965	1970	1975	1976	1977	1978
Mining	.6267	.7143	.7949	.8556	.9009	.9690	.9190	.9459
Construction	.79	.5862	.6460	.7279	.8374	.6906	.720	.766
Manufacturing	.2440	.5137	.6531	.5457	.6886	.6714	.650	.596
Transportation, Communication, Public Utilities	.8248	.9683	.9125	.8851	.9887	.8871	1.035	.908
Trade	.9226	.9718	.9905	.9733	1.0048	.9120	.985	.961
Finance, Insurance, and Real Estate	1.0	1.0	.9706	.8942	1.0	.927	1.040	.979
Services	.9583	.9123	.9664	.9716	.9812	.9387	.936	.923
Government	.9632	.9815	.9617	.9810	1.0049	.9689	1.005	1.112
Total	.7505	.8313	.8718	.88	.9402	.8733	.935	.940

SOURCE: State of Alaska, Alaska Labor Force Estimates, various years.

Price Levels and Inflation. Perhaps the most commonly recognized characteristic of the Alaskan economy is its high price level relative to the United States. Cost-of-living differences have been estimated at between 37 and 66 percent between Anchorage residents and U.S. urban dwellers on average. Price differences are much more accentuated in rural areas, possibly as high as 70 percent more than Anchorage (see Scott, 1978). This price differential is attributable to a wide variety of causes including high transport costs to and within Alaska, high construction costs, uncertainties and delays in shipping, and rapid fluctuations in both private and government activity that create shortages and bottlenecks within the state.

What is less commonly recognized than the high level of Alaskan prices is their tendency to increase at a rate less than that of the United States. Figure 16 shows the rate of inflation in Alaska and the United States as a whole. Generally, there has been an historical tendency of Alaskan inflation to remain below the U.S. level. This effect is to be expected in a developing economy, as expansion of markets permits realization of economies of scale in transportation and distribution and improved infrastructure generally reduces the costs of market transactions. There is a notable exception to this principle, however, namely when the growth occurs at a rate so fast as to create bottlenecks and shortages before the existing infrastructure can adjust to the new capacity requirement. Price increases then serve as the adjustment mechanism; and in such cases, Alaskan inflation has actually run ahead of that in the United States. However, as seen in the figure, this has

FIGURE 16. ALASKAN AND U.S. INFLATION, 1965-1978



	USINF	ANINF
1965	0.016	0.003
1966	0.03	0.039
1967	0.028	0.021
1968	0.042	0.026
1969	0.054	0.032
1970	0.059	0.035
1971	0.042	0.03
1972	0.033	0.027
1973	0.062	0.042
1974	0.11	0.108
1975	0.091	0.137
1976	0.057	0.072
1977	0.065	0.072
1978	0.076	0.071

SOURCE: Based on U.S. consumer price index and Anchorage consumer price index estimated by U.S. Department of Labor, Bureau of Labor Statistics.

happened in only four of the years since 1965; and three of these years (1975 to 1977) reflected the effects of the pipeline construction. Thus, while periods of rapid expansion may generate adverse price effects, the general tendency of stable growth is characterized by rates of increase lower than the United States, implying a long-term tendency toward equalization of price levels.

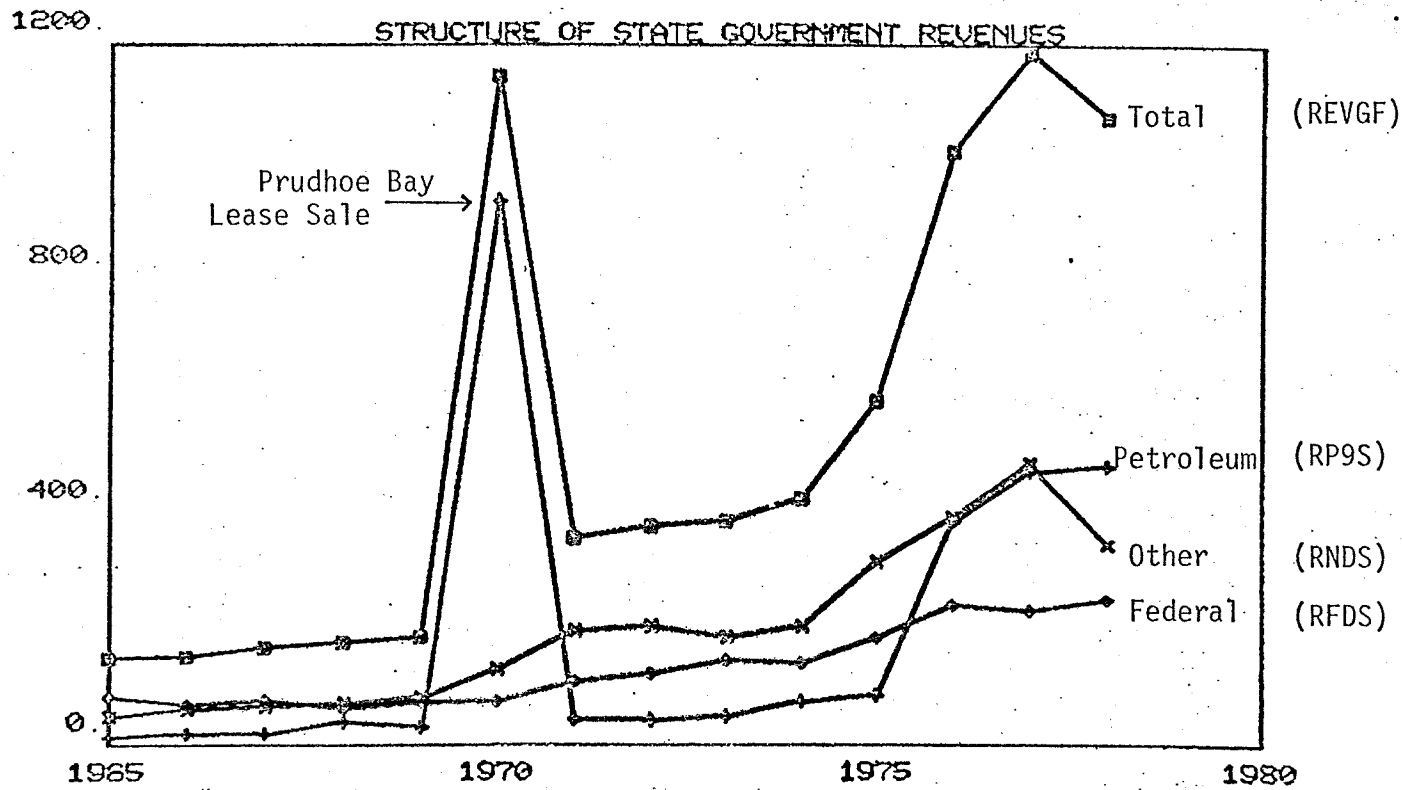
The Role of State Government. Probably the most significant long-term structural change induced by Alaskan petroleum development will be the alteration in the role of state government in the economy. Part of this change had already been realized during the historical period, but much of the change will occur in the future.

As shown in Figure 17, the state's annual general fund revenues by 1978 had risen to more than seven times their 1965 levels. These revenues can be divided into three broad groups: petroleum revenues such as production taxes, royalties, and property taxes; federal grants; and revenues from a variety of nonpetroleum state taxes such as income and corporate taxes.

Federal grants in aid were the major source of state revenues through most of the 1960s, accounting for over 55 percent of general fund revenues in 1965. After 1970, growth in such grants expanded rapidly, growing at over 15 percent annually. Because they are tied closely to population, such grants are likely to continue to grow into the future. However, as a share of total revenues, their contribution has fallen over time, to about a fifth of total revenues by 1978.

FIGURE 17. STATE GOVERNMENT REVENUES, 1965-1978

(millions of current dollars)



	REVGF	RP9S	RNDS	RFDS
1965	150.987	16.473	51.209	83.305
1966	152.564	21.601	61.545	69.418
1967	168.507	21.466	67.837	79.204
1968	177.628	42.967	72.944	61.717
1969	188.119	32.841	81.829	73.449
1970	1146.22	936.182	133.525	76.513
1971	355.991	47.702	197.76	110.529
1972	376.236	45.308	206.771	124.157
1973	385.462	51.249	188.624	145.589
1974	424.578	76.838	206.428	141.312
1975	583.82	87.49	315.125	186.205
1976	1017.83	385.756	391.375	240.703
1977	1186.5	472.596	484.285	229.624
1978	1073.37	480.81	344.756	247.8

SOURCE: Alaska Department of Revenue, Revenue Sources, various issues.

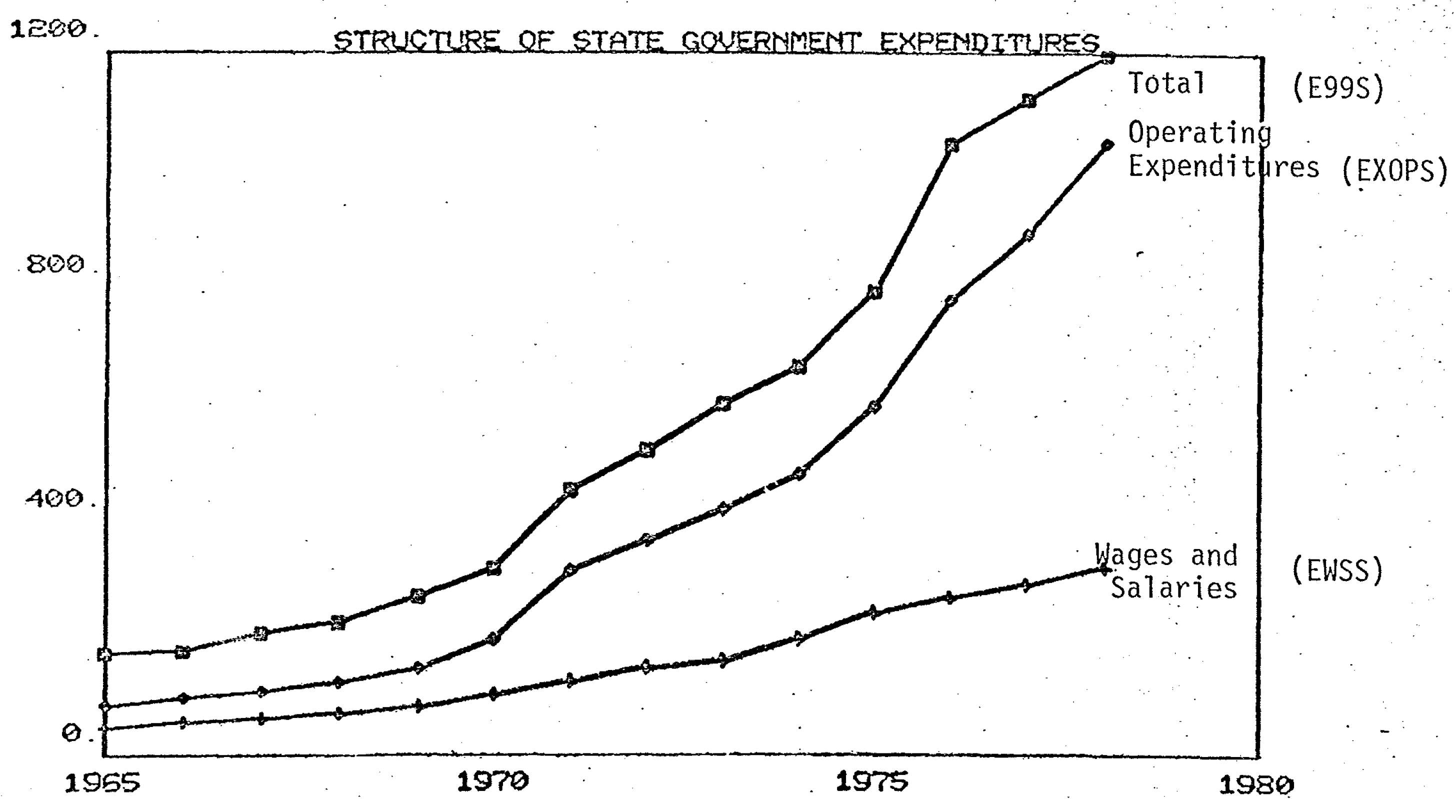
A variety of nonpetroleum-related state revenues such as the corporate and personal income taxes, interest earnings, and a variety of license and various other fees contributed greatly to the growth of state revenues over the period. Between 1970 and 1979, such revenues grew at an annual rate of 14.5 percent, contributing nearly a third of state revenues by 1979.

However, the major structural change in the pattern of state revenues is the growing dominance of petroleum revenues due to the development of Prudhoe Bay. The first major impact of such development occurred in fiscal 1970 when the sale of drilling rights brought the state over 900 million dollars in revenue, over 4.5 times the level of revenues from all other sources in 1970. This surplus was used largely to finance expanded services through the mid-seventies, before production from Prudhoe would initiate the flow of royalty and severance tax revenues. Production began in 1977, and by 1979 associated revenues were contributing over 48 percent of total general fund revenues.

State government expenditures, as shown in Figure 18, also grew nearly sevenfold between 1965 and 1978. Generally, three distinct subperiods can be identified during the period--the pre-Prudhoe sale period from 1965 until 1970, the pre-production period in the interim between the sale and the onset of Prudhoe production (1971-76), and the production period from 1977 to 1978. Before the Prudhoe sale, expenditure growth was constrained by the availability of revenues. Expenditure growth between 1965 and 1970 averaged 12.6 percent annually. Between 1970 and

FIGURE 18. STATE GOVERNMENT EXPENDITURES, 1965-1978

(millions of current dollars)



	E99S	EXOPS	EWSS
1965	175.531	88.4	52.244
1966	179.837	100.5	59.82
1967	211.124	113.6	67.6
1968	228.245	129.3	76.688
1969	271.559	152.1	88.125
1970	318.386	199.	107.75
1971	455.044	315.8	131.019
1972	524.41	366.5	154.192
1973	601.833	421.8	163.747
1974	665.766	482.3	200.747
1975	793.386	597.6	244.023
1976	1043.46	778.9	269.357
1977	1122.13	895.1	290.933
1978	1200.	1047.	322.493

SOURCE: Alaska Office of the Governor, The Executive Budget, various issues.

1976, the growth of expenditures accelerated to nearly 22 percent annually, spurred by increased demands for public services throughout the pipeline construction and financed by the surplus from the Prudhoe sale and later by a tax on reserves in place at Prudhoe. Since 1976, expenditure growth has stabilized at an average 7.3 percent annual rate of increase.

As shown in Figure 18, wages and salaries paid to state workers maintained a stable share of total expenditures, varying only between a third and a fourth of total expenditures during the period. Growth in such wage and salary payments averaged 15 percent annually over the period, although employment grew at only about 8 percent until peaking in 1975, then actually declined until 1978 when it began to grow modestly again. The more rapid growth in wages financed a growth in real wages at over 7 percent annually. While real wages for the civilian sector as a whole fluctuated wildly during the period immediately prior to and after the peak of pipeline construction, by 1978 real civilian wage rates generally were only 21 percent higher than their 1965 levels. Real wage rates in state government, on the other hand, were 48 percent higher by 1978.

Limiting the analysis to state employees, however, understates the full impact of the expansion of state expenditures on the economy. As shown in Figure 18, while state government wages and salaries occupied a fairly stable share of state expenditures, total operating expenditures did not. In fact, operating expenditures rose from less than half (46 percent) of the budget in 1965 to over 87 percent of the budget in 1978, reflecting largely the transfer of functions to a rapidly expanding local government sector. Largely financed by state transfers, local employment nearly quadrupled during the period, growing at an average 10.8 percent annual rate.

Over the period, combined state and local government grew from 11.8 percent to 18.4 percent of total wage and salary employment and raised its share of total wage and salary payments from 12.7 percent to 19 percent. Even more significantly, the revenue claims on future production at Prudhoe alone promise to accelerate the state government role in the economy, both as an employer and as a provider of direct investment. The overtaking of expenditures by state revenues and their expected rapid growth provide the state with a wide range of future expenditure options, which will be discussed below.

The Regional Economies of Anchorage and the Norton Sound Area

The impacts of proposed federal OCS developments in the Norton Sound area are likely to be concentrated in two areas of the state: Anchorage, because of its role as a statewide support center; and the area surrounding Norton Sound, because of its proximity to production operations. Consequently, this section examines the historical development of these two local economies in order to provide a point of reference for development of the base case forecasts to be presented below.