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Projected Employment and Population Impacts of Oil Shale Development in Uintah County, Utah

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PROJECTED EMPLOYMENT AND POPULATION IMPACTS OF OIL SHALE DEVELOPMENT IN UINTAH COUNTY, UTAH

by

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ABSTRACT

Projected Employment and Population Impacts of Oil Shale Development in Uintah County, Utah

by

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This study provides a critique of regional base method for population and employment impacts. It uses a new approach to calculate the regional employment multiplier. The new approach tries to preserve the advantages of the regional base method and at the same time avoid some of the problems associated with it.

This study estimates the changes in local service employment by industry and population in Uintah County, Utah, resulting from an oil shale development project with a 100,000 barrel-per-day capacity and an operating labor force of 2500. It also estimates the changes in total local service employment and population on a yearly basis for a period of 20 years.

(74 pages)

CHAPTER I

INTRODUCTION

The National Situation

The United States faced a shortage of energy during 1973, and since that time has experienced rapidly rising energy costs. (A shortage in a product will occur when the quantity demanded exceeds the supply. A shortage will not occur until a product's price is constrained from rising to its market-clearing level.) Responding to the crisis, the Federal Government, through its different agencies, placed ceilings on the prices of oil and natural gas at prices lower than market levels.

As one observer noted, for example:

> The shortage of natural gas is a direct result of the Federal Power Commission (FPC) ceilings imposed on the price producers are allowed to charge for natural gas sold in the interstate market. The price ceilings had two effects which have resulted in the current shortage of natural gas. Demand for natural gas was stimulated by artificially lowering prices, whereas supply was reduced by lower-than-free-market prices. (Erickson and Waverman, 1974, p. 30)

In addition, other governmental actions led to reductions in the rate of increase in energy supplies. Some of these governmental actions included the 1969 Environmental Protection Act and the 1970 Clean Air Act. These acts delayed the construction of the Trans-Alaskan pipeline, postponed off-shore drilling and exploration for new crude oil and natural gas and limited the construction of new hydroelectric power and nuclear plants. There was also an increase in the demand for oil due to substitution away from coal to meet mandatory emission standards.

Other major policies affecting domestic petroleum market conditions included the import quota program and the Jones Act. The import quota program was designed to encourage domestic crude oil producers to increase outputs by restricting foreign oil imports. The Jones Act of 1920 allows only inter-continental oil traffic in non-United States vessels and provides that:

> No merchandise shall be transported by water...in any other vessel than...(one)...built in and documented under the laws of the United States and owned by persons who are citizens of the United States... Enforcement of the Jones Act raises the annual cost of transporting oil from Texas and Louisiana to the United States East Coast by at least $100 million. (Mackne, 1974, p. 122-123).[1]

To meet the United States demand for energy, President Nixon suggested these steps in his "Special Message to Congress on Energy and Resources" on April 18, 1973:

> -increase domestic production of all forms of energy;
> -act to conserve energy more effectively;
> -strive to meet our energy needs at the lowest cost consistent with the protection of both our national security and our natural environment;
> -act in concert with other nations to conduct research in the energy field and to find ways to prevent serious shortage; and
> -apply our vast scientific and technological capacities - both public and private - so we can utilize our current energy resources more wisely and develop new sources and new forms of energy. (Goodwin, 1974, p. 250).

In "Project Independence," President Nixon proposed the development of domestic energy resources of natural gas, oil, oil shale, coal, and nuclear energy. The President also stated:

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[1]For additional information see, R. H. Connery and R. S. Gilmour, The National Energy Problem, E. C. Heath and Co., 1974; E. W. Erickson and L. Waverman, The Energy Question and International Failure of Policy, Vol. 2 North America, University of Toronto Press, 1974; R. B. Mancke, The Failure of U. S. Energy Policy, Columbia University Press, 1974.

> In determining how we should expand and develop these resources...we must take into account not only our economic goals, but also our environmental goals and our national security goals... It is essential that we strike the right balance among these priorities. (Goodwin, 1974, p. 249)

The resulting policy, which came to be called "Project Independence" was designed to supply the needs of the United States in energy and to make the United States self-sufficient in energy by 1980. The development of domestic energy resources was encouraged in order to avoid excessive dependence on foreign supplies. The rationale for this policy is the view that adequate and reliable energy supplies to the United States are fundamental to natioanl security and economic prosperity.

Oil shale

As previously noted, one of the domestic energy resources that President Nixon proposed developing in "Project Independence" was oil shale. In the United States oil shale deposits lie in three western states: Colorado, Wyoming, and Utah. Most of the oil shale deposits are on federal land.

> Oil shale is a laminated maristone rock containing a tar-like organic material called kerogen. When heated to 450 degrees - 600 degrees Centigrade, kerogen undergoes pyrolysis (decomposition) to yield raw shale oil. The viscous petroleum - like material can be refined into a complete line of petroleum products by conventional refinery techniques. (Federal Energy Administration, 1974, p. 129)

Oil shale yields 10 to 40 gallons per ton (GPT) of processed shale. The oil shale deposits in the Green River Formation of Colorado, Wyoming, and Utah are estimated to contain a yield of more than 2 trillion barrels of oil. (Douglas, 1968, p. 29) The Green River Formation contains an estimated 600 billion barrels in shale averaging 25 gallons or more per ton (GPT) in strata of 10 feet or more thick

(U. S. Government Printing Office, 1974, p. 2). The 10-foot strata thickness is viewed as the minimum thickness for economically feasible production.

In his "Special Message to Congress on Energy and Resources," the President asked the Department of the Interior to develop an oil shale leasing program. In response, the Department developed the Prototype Oil Shale Leasing Program and offered six tracts for lease, two each in Colorado, Wyoming, and Utah. Mr. Rogers Morton, Secretary of the Interior stated that:

> The prototype program was designed with these goals in mind:
> 1. to develop a new source of energy to the nation by stimulating the development of commercial oil shale technology by private industry;
> 2. to insure the environmental integrity of the affected areas and at the same time to develop a full range of environmental safeguards and restoration techniques that will be incorporated into the planning of a mature oil shale industry, should one develop;
> 3. to permit an equitable return to all parties in the development of this public resource; and
> 4. to develop management expertise in the leasing and supervision of oil shale development inorder to provide the basis for future administrative prodedures.
> (U. S. Government Printing Office, 1974, p. 70)

The announced goal of the Leasing Program of an equitable return to the companies which develop the oil shale involved two important problems. First, the cost estimates of a production plant producing oil from shale were subject to a wide estimating error. Secondly, there were grave doubts about the future level of crude oil prices (Mead, 1975, p. 5, 7). Given costs (1973) and technology, it is estimated that in order to profitably produce oil from shale, the price of a barrel of oil must be $8 to $10 per barrel (estimated 1978 prices). The current price (August, 1975) of crude oil is $11.50 per barrel.

Due to the Current high price of conventional oil, it may now be feasible to produce synthetic oil from shale. However, uncertainties in conventional oil prices mean that some form of governmental subsidy may be required if desirable.

The impacts of oil shale development on Uintah County

The Department of the Interior leased two oil shale tracts in Utah, designated "Ua and "Ub." On March 12, and April 12, 1974, under the Prototype Oil Shale Leasing Program. Phillips Petroleum and Sun Oil Companies submitted the highest bid for tract Ua, $75,596,800, to develop the 5120 acre site. (Salt Lake Tribune, March 13, 1974) Ub, also a 5120 acre site, received a bid of $45,107,200 by the White River Shale Oil Corporation, a combine of Phillips Petroleum, Sun Oil and Sohio Petroleum Companies. (Salt Lake Tribune, April 10, 1974) The oil companies which leased Ua and Ub will pay the sum bid in five equal annual installments. If the companies relinquish or surrender their rights after 3 years, they are released from any obligation to pay the fourth and the fifth installments.

> The Lessee may credit against the fourth bonus installment any expenditures prior to the third Anniversary Date directly attributable to operations under this lease on the Leased Lands for the development of the Leased Deposits, but not any expenditures attributable to the preparation of a development plan... Upon the credit of an expenditure, the Lessee shall be relieved of the duty of paying the equivalent amount of the fourth bonus installment. (Department of the Interior, Bureau of Land Management, 1974, p. 12)

This credit provision is also applied to the fifth bonus installment. The lease is for a period of 20 years. It is renewable

if there is production in commercial quantities[2] subject to readjustment of terms and conditions of the lease.[3]

The impact of the oil shale industry on Uintah County depends upon the level and method of production of the shale oil. There are two methods of producing oil shale - mining and crushing, and "in-situ." In the former, the shale is mined and crushed by standard techniques, after which the crushed shale is placed in a retort. The kerogen, or oil shale content, is recovered by heat either being applied directly in the retort or indirectly by the passage of heated gasses through the retort. The "in-situ" method is an underground method, in which the hydrocarbon content is gathered by heating the shale in place underground. Representatives of Phillips Petroleum and Sun Oil indicated on March 12, 1974, that they plan to produce oil from shale in Utah by using the retorting method. They also anticipated the production of 50,000 barrels of crude oil per day. (Salt Lake Tribune, Salt Lake City, March 13, 1974: 23) Recently, however, the White River Oil Shale Project has updated its estimated production and employment schedule. It is anticipated that the production level will approach 100,000 barrels per day over an 11-year period. A level of employment of 2,500 operating workers is envisaged after that time. The schedule is discussed further in Chapter V.

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[2]Commercial Quantities" means quantities sufficient to provide a return after all variable costs of production have been met.

[3]For more detail see: United States Department of the Interior, Bureau of Land Management, Final Environmental Statement for the Prototype Oil Shale Leasing Program, Vol. III, Chapter V. U. S. Government Printing Office, Washington, D. C., 1973.

Objectives and methodology of this study: brief summary

This study estimates the population and employment impacts of the proposed oil-shale production facility in Uintah County, Utah. The methodology employed in this study is the "economic base" or "regional base" method. This method divides economic activities within a region into two sectors: a basic (export) sector and a non-basic (local service) sector. The basic sector includes all the economic activities that are exported outside the region's boundaries. The non-basic sector includes all of the economic activities that are sold locally inside the region. After separating the two major sectors, a regional base multiplier is calculated by using the relationship between total employment and basic employment. The economic base method will be fully discussed in Chapter III.

The development of the oil-shale industry in the county will generally effect the population size and composition, employment size and classification, basic and non-basic services, and the size and composition of economic activities.

Development of the oil shale lease site would involve two stages. The first stage is the construction of the plant. The construction stage is characterized by the immigration of a temporary labor force in the county. The second stage, the operating stage, will involve immigration of the labor force needed for the on-going operation of the new industry.

The construction labor force tends to have a high proportion of single men and workers who leave their families in other parts of the country. They tend to prefer temporary quarters, mobile houses, campers, or trailers. The operating labor force will be permanent

residents of the county due to the location of the operating site. The operating labor force will increase the demand for permanent housing, schools, recreational areas and a multitude of public and private services to a greater extent than the construction force.

The development of an oil shale industry in Uintah County will create rapid population growth and will have many socio-economic impacts. Some of the major problems resulting from these impacts include the following: (1) housing costs will rise and shortages may develop due to the inability of the housing market to immediately respond to increased demand. This will occur during the construction stage and in the early years of the operating stage; (2) a large increase in demand for mobile homes and trailer parks in the construction stage will require public planning. Unplanned, uncontrolled mobile home use may lead to problems of sewage, water supply, and other utilities, as well as aesthetic and health problems; (3) provision of public services and utilities, including sewage, garbage, water supply, electricity, transportation, educational facilities, police and fire protection may lag behind the increase in demand, due to the inability of local institutions to cope with these rapid changes.

In summary, a first step toward the prevention or solution of problems of rapid development is the estimation of future population and labor force changes. To accomplish this, this study has the following objectives:

1. To develop a methodology for calculating a regional employment multiplier that is applicable to Uintah County.

2. To estimate for the county changes in employment by industry, resulting from the development of an oil shale industry with a labor force of 2,500 and a 100,000 barrel per day crude oil production level.

3. To estimate the resulting change in the total population of Uintah County.

4. To estimate the growth paths of employment and population during the years between the inception and completion of the project.

CHAPTER II

SOCIAL AND ECONOMIC CHARACTERISTICS OF UINTAH COUNTY

Population

Uintah County, Utah, as shown in Figure 1, lies adjacent to Colorado in the northeast part of the state. It has an area of 4487 square miles. The nearest major population center is the Salt Lake City area which is approximately 150 miles away.

The growth of the Uintah County population over the past several decades is shown in Table 1. The population of Uintah County has never been a significant proportion of the total population in Utah, and up to 1970, showed a decline relative to both Utah and the United States. However, between 1971 and 1974, Uintah County has showed a higher rate of population increase than the state and the nation. Table 1 shows that Uintah County's population increased by 27 percent compared to 10.8 percent for Utah and 4.0 percent to the United States. The explanation for this is found in the rate of in-migration. The net migration was 18.4 percent from 1970 to 1974. (U.S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census, Series P25, April, 1975)

The relatively lower rate of population increase in Uintah County from 1940 to 1970 is primarily due to out-migration rather than to a lower rate of natural increase. Table 2 shows that the percentage of natural increase in Uintah County and the State of Utah are almost

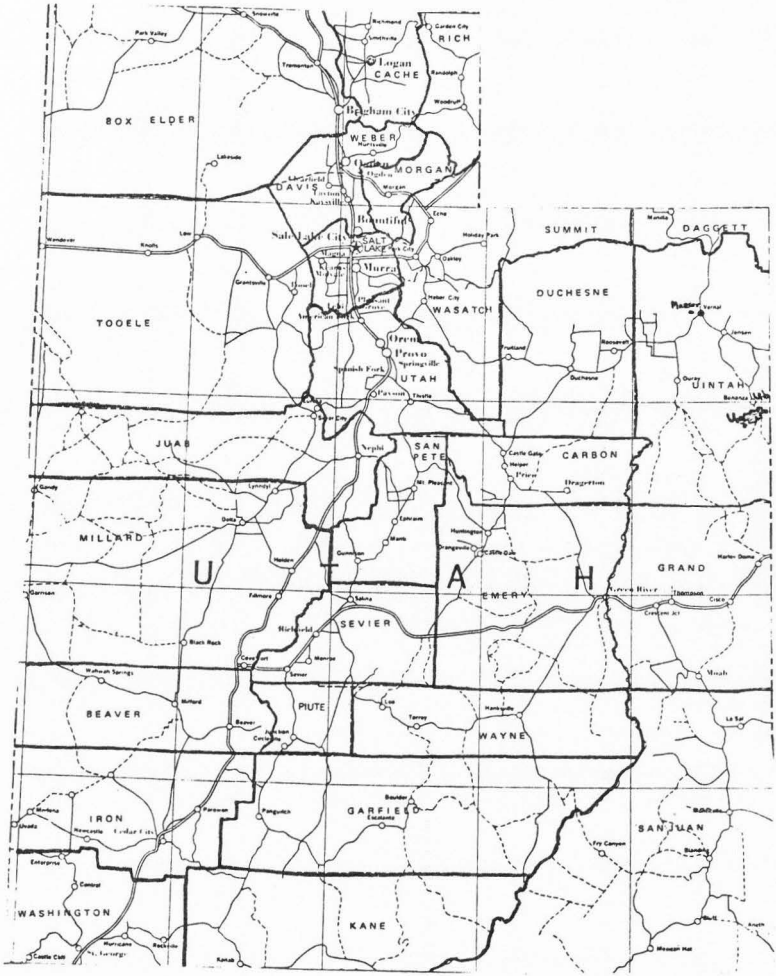

Figure 1. Tracts Ua and Ub in Uintah County.

Table 1. Population of Uintah County, State of Utah and the U. S., for selected years

Year	Uintah Popu-lation	Uintah Percent change from last census	Utah Popu-lation	Utah Percent change from last census	U. S. Popu-lation	U. S. Percent change from last census	Uintah population as % of Utah population
1940	9898	9.6	550310	7.3	132164569	7.3	1.8
1950	10300	4.1	688862	25.2	151325798	14.5	1.5
1960	11582	12.5	890627	29.3	179323175	18.5	1.3
1970	12684	9.5	1059273	18.5	203211926	13.3	1.2
1971	13300	4.9	1095000	3.4	206212000	1.5	1.2
1972	14400	8.3	1128000	3.0	208230000	1.0	1.3
1973	15200	5.6	1150000	1.9	209844000	.8	1.3
1974	16100	5.9	1174000	2.1	211390000	.7	1.4

Source: U. S. Bureau of the Census, Census of Population 1940-1970 and Current Population Report (Washington, D. C., U. S. Government Printing Office).

Table 2. Components of change of population for Uintah County and Utah, 1950-1960 and 1960-1970.

	1950-1960			1960-1970		
	Percent net Change	Percent natural Increase	Percent net Migration	Percent net Change	Percent natural Increase	Percent net Migration
Uintah	12.5	26.1	-13.6	9.5	20.2	-10.7
Utah	29.3	27.8	+1.4	18.9	20.2	-1.2

Source: U. S. Bureau of the Census, Census of Population 1960-1970 (Washington, D. C.: U.S. Government Printing Office).

the same, and that migration is the main reason for the differences in the percentage of net change.

The county seat is Vernal, with a population of 4,924 in 1973. Like the county, this city has also been growing rapidly in recent years, with a population increase of 26 percent between 1970 and 1973.(U. S. Department of Commerce, Social and Economic Administration, Bureau of the Census P25 Series, April, 1975) The town of Maesar, with a population of 1,250 in 1970, is the only other town in the county having over 1,000 inhabitants.

Uintah County has a more rural population distribution than both Utah and the United States. The rural-urban distribution and population density are shown in Table 3.

Table 3 indicates a slower trend toward urbanization (even negative over 1960-1970 period) for Uintah County relative to the state and the nation.

Uintah County has a higher percentage of non-white population than the State of Utah. This is due to the Indian population, largely located on the Ute Indian Reservation. Table 4 shows the percentage distribution of population by race in Uintah County, Utah, and the United States.

The age level of Uintah County's population is slightly younger than that of Utah and the United States. In 1970, the median age in the county was 22.4 years, as compared with 23.1 years and 28.1 for the State and the nation, respectively. The age distribution of Uintah County, Utah and the United States are shown in Table 5.

The age distribution shows that 47.4 percent of the county's population is less than 20 years of age as compared with 43.3 percent

Table 3. Percent distribution of rural and urban population and density of population for Uintah County, Utah, and the U. S., 1940-1970

Year	Uintah				Utah				U.S.			
			Percent				Percent				Percent	
	Percent urban	Percent rural	change in urban from previous census	Population per square mile	Percent urban	Percent rural	change in urban from previous census	Population per square mile	Percent urban	Percent rural	change in urban from previous census	Population per square mile
1940	--	100.0	--	2.2	55.5	44.5	--	6.7	--	--	--	44.2
1950	27.6	72.4	27.6	2.3	65.3	34.7	41.7	8.4	64.0	36.0	20.6	50.7
1960	31.6	68.4	28.5	2.6	74.9	25.1	48.3	10.8	69.9	30.1	30.1	50.3
1970	30.8	69.2	6.9	2.8	80.4	19.6	27.6	12.9	73.5	26.5	19.2	57.5

Source: U. S. Bureau of the Census, Census of Population, 1940-1970 (Washington, D. C.: U. S. Printing Office).

Table 4. Percent distribution of population by race for Uintah County, Utah, and the U. S., 1970.

	White	Negro	Indian	All Others
Uintah	89.1	.01	10.5	.26
Utah	97.4	.6	1.1	.8
U.S.	87.5	11.1	.4	1.0

Source: U. S. Bureau of the Census, Census of Population, 1970. (Washington, D. C.: Government Printing Office).

Table 5. Percent distribution of population by age group of Uintah County, Utah, and the U. S., 1970.

Age Group	Uintah	Utah	U.S.
Under 5	10.9	10.6	8.4
5-14	26.1	22.7	20.0
15-19	10.4	11.0	9.4
20-24	5.5	9.3	8.1
25-44	23.2	22.4	23.6
45-64	17.0	16.7	20.6
65 and over	6.9	7.3	9.9
Median age	22.4	23.1	28.1

Source: U. S. Bureau of the Census, Census of Population, 1970 (Washington, D. C.: U. S. Government Printing Office).

for Utah and only 37.8 percent for the nation. This reflects the out-migration pattern of the county's young adults. The county has a correspondingly lower percentage of people in the labor force age group between 15 to 64 than the state or the nation.

Table 6 shows that the ratio of males per 100 females is higher in Uintah County than both the state or the nation. This finding is not unusual in rural areas as it is suggested that the female is more likely to migrate to urban areas for such reasons as employment and availability of other services not offered in rural areas.

Table 6. Males per 100 females for Uintah, Utah, and the United States, 1950-1970.

Year	Uintah	Utah	U.S.
1950	107.5	101.0	98.7
1960	106.9	99.8	97.1
1970	102.6	97.3	94.8

Source: U.S. Bureau of Census, Census of Population, 1950, 1960, and 1970. (Washington, D. C.: U. S. Government Printing Office)

Education and Housing

The general educational level of the Uintah County population has improved considerably in recent years. (see Table 7) In 1970, 84.7 percent of the population 25 years of age and over had completed at least one year of high school compared to 76 percent in 1960. Although this figure is higher than that for the state in 1970 (78.3), the percentage of the Uintah County population with post-high school education is less than that for the state.

Table 7. Percent distribution of population by years of school completed for persons 25 years old and over for Uintah County and Utah, 1960-1970.

		Uintah		Utah	
		1960	1970	1960	1970
No. school years completed		1.5	.7	.8	.8
Elementary:	1 to 4 years	2.2	1.4	2.0	2.0
	5 to 8 years	20.3	13.2	18.8	18.8
High School	1 to 4 years	60.8	62.7	53.1	53.1
College	1 to 3 years	9.1	13.4	15.0	15.0
	4 years +	6.1	8.6	10.2	10.2

Source: U. S. Bureau of Census, Census of Population, 1960-1970, (Washington, D. C., U. S. Government Printing Office).

Housing characteristics in Uintah County in 1970 were less favorable than in the state. Table 8 shows selected housing characteristics. Uintah County has a higher percentage of housing units in one unit structures than the state due to the more rural population distribution in the county than the state. Housing facilities, such as telephones, plumbing and air conditioners, in Uintah County are lower than the state. This is in part explained by the comparatively low average income that has existed in the county.

Table 9 showing new dwelling units for Vernal and Uintah County, indicates a large increase in permanent units in the county in the 1970's. This has been accompanied by a rapid increase in mobile homes, as shown in Table 10.

Table 8. Selected housing characteristics for Uintah County, and Utah, 1970.

	Uintah		Utah	
	Number	Percent	Number	Percent
All year round housing units	3,700	100.00	311,814	100.00
Units in structure				
one	3,085	83.4	234,476	75.2
two or more	318	8.6	69,106	22.2
mobile home or trailer	297	8.0	8,232	2.6
Year structure built				
1965-March 1970	486	13.1	37,362	12.0
1960-1964	504	13.6	45,984	14.7
1950-1959	810	21.9	73,471	23.5
1940-1949	759	20.5	46,228	14.8
1939 or earlier	1,141	30.8	108,937	34.9
Source of water				
public system or private company	3,057	82.6	296,114	94.9
individual well	284	7.7	12,329	3.9
other	353	9.6	3,431	1.1
Sewage disposal				
public sewer	1,622	43.9	258,649	82.9
septic tank or cesspool	1,875	50.8	49,249	15.9
other	197	5.3	3,976	1.2
Telephone				
available	2,988	87.0	271,470	91.1
none	455	13.0	26,464	8.9
Air Conditioning, Room Unit				
one	255	6.9	39,364	12.6
two or more	--	--	5,775	1.8
central system	180	4.8	35,485	11.4
none	3,259	88.2	231,250	74.0
Plumbing facilities				
with all plumbing facilities	3,484	94.2	303,257	97.3
lacking some or all plumbing facilities	216	5.8	8,557	2.7
lacking only hot water	--	--	1,059	0.3
lacking other plumbing facilities	216	5.8	7,998	2.4

Table 8. (continued)

	Uintah		Utah	
	Number	Percent	Number	Percent
Piped water in structure				
hot and cold	3,540	95.7	307,391	98.6
cold only	39	1.1	2,077	0.7
none	121	3.3	2,346	0.8
Flush toilet				
for exclusive use of household	3,495	94.5	305,391	97.9
also used by another household	--	--	2,323	0.7
none	205	5.5	4,100	1.3
Complete kitchen facilities				
for exclusive use of household	3,513	94.9	304,608	97.7
also used by another household	--	--	330	0.1
no complete kitchen facilities	187	5.1	6,876	2.2
Persons per room				
all occupied units	3,433	100.00	297,934	100.00
1.00 or less	2,949	85.9	268,052	90.0
1.01 to 1.50	336	9.9	24,231	8.1
1.51 or more	148	4.2	5,651	1.9

Source: U. S. Bureau of the Census, Census of Housing, 1970 (Washington D. C.: U. S. Government Printing Office).

Table 9. New dwelling units in Uintah County for selected years.

Year	Total	Vernal	All other	Percent change in total new dwellings
1967	17	10	7	-
1968	18	4	14	+5.9
1969	14	4	10	-22.2
1970	95	27	68	+578.6
1971	74	32	42	-22.1
1972	122	48	74	+64.9
1973	127	30	97	+4.1
1974	119	40	79	-6.2

Source: Bureau of Economic and Business Research, Utah Construction Report, 1967-1974, (University of Utah).

Table 10. New mobile homes in Uintah County for selected years.

Year	Mobile homes	Percent change
1971	24	-
1972	108	+350
1973	123	13.8
1974	93	-24.4

Government

Uintah County is governed by a three-member board of commissioners who are elected to carry out the executive and the legislative functions of the county government.

> Continuity of county government is provided in the staggered terms of office of the commissioners - two are elected for four years and one for two years. Thus, every two years in a county-wide partisan election, two commissioners are elected at large. (Bureau of Business and Research, Utah Facts, XVI, p. 7.)

Vernal, the county seat, is governed by a mayor and four (4) councilmen. Uintah County has six governmental units including the Board of County Commissioners. (U. S. Bureau of the Census, Census of Government, 1972) The county has a Planning Commission and Industrial Development Agency.

In 1974, the Utah governor established the Planning and Development Advisory Council to deal specifically with energy issues and problems. The council is under the direction of the Executive Director of the Uintah Basin Association of Governments.

Table 11 shows revenue sources for Uintah County. General property tax provides the most significant revenue source. Total revenues for 1972 was $710,729 and total expenditure was $780,677 for the same year. Table 12 shows the county's expenditures for 1972. Highways expenditures was the most significant expenditure item. Table 13 shows the distribution of property tax according to purpose. District schools received the largest proportion of property taxes. Table 14 shows federal revenue sharing allocations to Uintah County's governments.

Table 11. Total revenue sources of Uintah County, 1972.

Item	Uintah
Total Revenues	710,729
General property taxes	358,783
Other local taxes	44,132
Licenses and permits	2,527
Fines and forfeitures	23,317
Revenues from use of money and property	21,283
Revenue from other agencies	188,533
Charges for current services	71,111
Other revenues	1,043
Beginning Balance	
Total	710,729

Source: Department of Housing and Urban Development, 1972.

Table 12. Total expenditures of Uintah County, 1972.

Item	Uintah
Total Expenditures	780,677
Commissioners	15,379
Judicial	10,307
Administrative	73,116
Planning	
Education and public relations	25,711
General government building	15,362
Non-departmental	
Public safety	71,060
Highways	290,743
Weed control	23,003
Airports	892
Health and hospitals	42,420
Public welfare	7,252
Parks and recreation	23,916
Cemeteries	15,391
Bond issues	32,891
County library	19,688
Miscellaneous expenditures	
Capital outlay	
Surplus	
Total	780,677

Source: Department of Housing and Urban Development, 1972.

Table 13. Distribution of property taxes according to purpose for Uintah County, 1957-1973.

Year	District schools	Cities and towns	County	Roads	Special taxing districts	Bounty	Total
1973	$1,903,983	$73,091	$409,830	$_____	$79,731	$11,194	$2,477,829
1972	1,798,658	69,509	426,017	_____	55,593	13,780	2,363,557
1971	1,844,275	67,464	369,418	_____	57,418	15,960	2,354,634
1970	1,804,016	70,690	380,375	_____	41,359	14,755	2,111,195
1969	1,777,475	70,197	427,936	_____	44,302	15,907	2,335,617
1968	1,787,470	66,520	341,894	_____	27,425	12,352	2,235,661
1967	1,825,937	65,771	349,603	_____	28,018	13,815	2,283,144
1966	1,779,237	65,777	331,921	_____	30,807	12,134	2,219,876
1965	1,789,769	66,650	327,584	_____	26,969	12,382	2,223,354
1964	1,634,638	66,190	277,824	_____	31,682	10,693	2,021,027
1963	1,515,410	63,787	277,513	_____	30,559	10,867	1,898,136
1962	1,272,519	55,155	251,118	_____	27,609	10,722	1,617,123
1961	1,160,654	69,471	239,207	_____	25,071	12,727	1,587,130
1960	994,066	66,027	182,412	34,945	22,753	11,434	1,311,637
1959	905,064	65,377	170,581	35,912	20,829	11,992	1,209,755
1958	667,945	65,405	165,348	37,451	18,177	13,437	957,753
1957	565,969	53,424	65,372	39,958	7,743	13,070	745,526

Source: Property Tax Division Utah State Tax Commission, Statistical Study of Assessed Valuations, 1957-1973.

Table 14. Federal revenue sharing allocations to all Uintah County's local governments, 1972.

Item	Amount
Allocation for 1972	
Amount	$223,886.00
Per Capita	17.65
Mill Levy Equivalent	6.20

Source: Compiled by Utah Foundation from data released by the Office of Revenue Sharing, U. S. Department of the Treasury, Population data from U.S. Bureau of the Census and property tax assessment data from Utah State Tax Commission.

Table 15 shows Uintah County's government employment. Hospital employment is larger than any other individual governmental agencies followed by highway employment.

Income and Employment

Both the level and the percentage increase in per capita income in Uintah County in recent decades has been lower than Utah and the nation. This is shown in Table 16. From 1970 up to 1974, per capita income has grown dramatically in the county, and is now almost equal to that of the state. In 1974, the per capita income of Uintah County was $4,400 having increased by 50.2 percent from 1970 to 1974. Utah's per capita income increased by 32.2 percent over the same period to a level of $4,480. (Utah Department of Employment Security, Newsletter, Salt Lake City)

Table 17 shows the percentage distribution of employed persons by industry group. Agricultural employment in 1970 constituted almost 12 percent of the total employment which is high in comparison with Utah

Table 15. Employment statistics for Uintah County governments, October, 1972.

Item	
Employees	
Total	110
Full-time only	59
October Payroll ($1,000)	
Full-time equivalent employment	
Total	67
Education	--
Other than education, total	67
Highways	20
Public welfare	--
Hospitals	25
Health	3
Police protection	5
Financial administration	9
General control	5

Source: U.S. Bureau of the Census, Census of Governments, 1972, Vol. 3, Public Employment No. 1.

Table 16. Per capita income of Uintah County, Utah and the U.S., 1960-1970.

	1960 Per capita income ($)	1970 Per capita income ($)	Percent change 1960-1970 ($)
Uintah	1840	2780	59.2
Utah	1970	3200	72.1
U.S.	2216	3933	77.5

Source: Bureau of Economic and Business Research, Statistical Abstract of Utah, 1973. (Center for Economic and Community Development, University of Utah, Salt Lake City.)

and national levels. Recently, however, agriculture employment in Uintah County has been following the national trend of both relative and absolute decline. Starting from a large base, the relative size of this decline has been quite marked within the county. The fact that agriculture employment, which is largely self-employment, dropped from 19 to 12 percent of the labor force may explain a large shift in income source toward wage and salary income in the 1960-1970 period. In 1960, 67.3 percent of the personal income was obtained from wages and salaries compared to 86.9 percent in 1970. Mining employment in the county is high, reflecting the importance of the oil industry in the county.

The manufacturing sector, a large source of employment at the national level, is very small in Uintah County.

Table 18 shows the number of employees on non-agricultural payrolls from 1960 to 1973. Although manufacturing increased by 96 percent, it constituted only 6.6 percent of non-agricultural employment in 1973. In contrast, the national level was over 26 percent in 1970. As indicated by the employment data in Table 17, mining is a major industry in Uintah County. The value of mineral products in Uintah County tends to fluctuate rather widely from year to year. In general, there has not been a discernable trend in recent years in the nominal value of mineral production, and when higher prices are taken into account the real value of output appears to have fallen. Table 19 shows the value of mineral products since 1960.

Crude petroleum products constitute the major part of the mineral products in Uintah County. The oil industry began in 1948 in Uintah County

Table 17. Percent distribution of employed persons by industry group for Uintah County, State of Utah, and the U.S., 1960-1970

	Uintah		Utah		U. S.	
	1960	1970	1960	1970	1960	1970
Agriculture, Forestry and Fisheries	19.15	11.8	6.1	3.8	6.7	3.7
Mining	16.3	17.5	4.4	3.1	1.0	0.8
Construction	9.2	6.5	6.9	5.4	5.9	5.9
Manufacturing	5.0	5.5	16.0	14.5	27.1	25.9
Railroads and Railway Services	-	-	2.9	1.5	1.5	0.8
Trucking Services and Warehousing	2.1	1.6	1.6	1.6	1.4	1.4
Other Transportation	0.6	0.8	0.8	0.7	1.4	1.4
Communications	1.17	1.1	1.3	1.2	1.3	1.4
Utilities and Sanitary Services	2.29	2.1	1.5	1.5	1.4	1.6
Wholesale Trade	1.4	3.4	3.9	4.5	3.4	4.1
Food and Dairy Products Stores	1.6	2.6	2.6	2.5	2.6	2.5
Eating and Drinking Places	2.6	3.5	3.0	3.6	2.8	3.0
Other Retail Trade	10.9	13.5	10.4	10.8	9.4	10.5
Finance, Insurance and Real Estate	1.3	2.5	4.0	4.2	4.2	5.0
Business Services	0.3	-	0.9	1.3	1.2	1.7
Repair Services	2.1	1.9	1.3	1.4	1.3	1.4
Private Households	1.9	0.7	1.7	0.7	3.0	1.5
Other Personal Services	4.1	2.7	3.1	3.1	3.0	3.2
Entertainment and Recreation Services	0.5	0.4	0.9	1.0	0.8	0.8

Table 17. (continued)

	Uintah		Utah		U.S.	
	1960	1970	1960	1970	1960	1970
Educational Services	6.5	8.8	7.8	11.7	5.2	8.0
Welfare, Religious and Nonprofit Membership Organizations	1.9	0.7	1.4	1.6	1.3	1.5
Hospitals	0.6	3.1	2.4	5.0	2.6	5.5
Other Professional and Related Services	1.5	1.0	2.4	2.2	2.5	2.6
Public Administration	4.2	8.1	10.4	12.6	5.0	5.5
Industry not Reported	2.1	-	2.7	-	4.0	-

Source: U. S. Bureau of Census, Census of Population 1960-1970, (Washington, D.C., U. S. Government Printing Office).

Table 18. Employees on non-agriculture payrolls by major industry group for selected years.

Year	Total	Manu-facturing	Construc-tion	Transporta-tion commu-nication and public utilities	Trade	Finance insurance and real estate	Services and misc.	Government	Mining
1960	3001	165	376	166	523	59	235	649	838
1965	3023	117	132	143	615	66	260	806	884
1968	3163	125	157	162	660	74	377	896	712
1969	3419	189	188	172	691	72	449	841	817
1970	3510	249	180	177	711	74	548	860	711
1971	3852	318	150	210	824	79	666	826	779
1972	4655	316	255	300	1001	95	838	900	950
1973*	4910	325	240	370	1115	110	915	855	980
1974	5439	333	317	416	1221	W	976	954	W

*Utah Industrial Development Information System: County Economic Facts, 1974, Uintah County.
W - Withheld for Disclosure of Individual Firm data.

Source: Utah Department of Employment Security, Utah Labor Market Information, 1950-1974.

Table 19. Value of mineral products of Uintah County and Utah for selected years, 1960-1972

Year	Uintah $	Uintah Percent of Increase	County as of Utah Percent	Utah $	Utah Percent of Increase
1960	27,139	-	6.29	431,383	-
1970	27,915	.028	4.63	601,997	.395
1971	29,228	4.7	5.56	525,700	-12.8
1972	25,733	-11.9	4.74	542,809	3.3

$ in millions of dollars

Source: U. S. Department of the Interior, Minerals Yearbook 1960, 1970, and 1972: (Washington, D.C., U. S. Government Printing Office).

and all the oil produced in Utah was from Uintah County up to 1951. Crude oil production grew rapidly until the early 1960's, since that time production has fluctuated around a level of about 6 million barrels per year. Table 20 shows crude petroleum products for selected years in Uintah County. The number of drilling explorations during the period 1969 to 1972 had decreased by 50 percent or from 42 in 1969 to 21 in 1972. The number of proved oil and gas wells had also decreased. For example, in 1969 there were 17 oil wells and nine gas wells discovered, whereas only three oil wells and six gas wells were discovered in 1972. (Department of the Interior, Minerals Yearbook, 1970, 1971, and 1972)

Table 20. Crude petroleum products* of Uintah County and Utah for selected years, 1951-1972 (42 gallon barrels).

	1951	1960	1970	1971	1972
Uintah	1,305	5,630	6,265	6,244	5,444
Utah	1,305	37,599	23,370	23,630	26,570
Uintah as percent of Utah	100.00	14.9	26.8	26.4	20.0

*In millions of barrels

Source: U. S. Department of the Interior, Minerals Yearbook, 1951, 1960, 1970, and 1972; (Washington, D. C., U. S. Government Printing Office).

Summary

The growth in Uintah County during the 1950 decade was significantly higher than the period prior to World War II. The major reason for this rapid growth was the exploration and production of oil. During the 1960 decade there was a leveling off of this rapid growth rate due to the stable level of oil production to approximately 5 million barrels of oil per year.

The recent period 1971-1974 has been one of rapid growth in employment and population in Uintah County due to the increased activities of oil and gas exploration and production. The more apparent economic indicies of population, employment, income, etc. have been increasing at significantly higher rates than those of the 1960-1970 period.

CHAPTER III

REGIONAL ANALYSIS METHODOLOGY: BACKGROUND

Introduction

This chapter is a general review of regional economic methods relevant to this study, that is, those methods which estimate the economic growth and the socio-economic impacts on a region resulting from exogenous economic changes. Such changes, which include new industries, demand changes, and government installations, have many impacts on the region's population, labor force, economic and social services, and income.

This chapter discusses first the rationale for using the economic base method rather than the input-output approach. This is followed by a discussion of economic base method and the regional multiplier concept including the various methods used in classifying basic and non-basic industries. Finally, problems associated with the choice of a unit of measure are briefly taken up.

The Regional Input-Output Approach

The regional input-output approach divides all market-related economic activities of a region into sections (or industries). Expenditures made by one sector of the economy are receipts for other sectors. An input-output flow matrix identifies the purchases of each industry from other industries. It also shows how the output of each industry is distributed among other industries. Table 21 is a

hypothetical input-output flow matrix which summarizes the transactions of a region. The table is simplified in order to bring out the relationships to be illustrated.

Table 21. Hypothetical input-output flow table: Region A, 1974. (in millions of dollars)

Industry Producing	Industry Purchasing: Agriculture	Manufacturing	Trade & service	Households	Exports	Total outputs
	1	2	3	4	5	6
1. Agriculture	2	5	2	4	6	19
2. Manufacturing	4	3	2	5	6	20
3. Trade & Service	4	3	3	1	-	11
4. Households	6	5	1	4	-	16
5. Imports	3	4	3	2	-	12
6. Total Inputs	19	20	11	16	12	78

Rows 1 through 5 show the distribution of the production of each sector to other sectors. Columns 1 through 5 show the flow of inputs to each sector from all the sectors.

The information in Table 22 is used to calculate production coefficients. Production coefficients are calculated for each sector by dividing the total value of output at the bottom of each column into the inputs listed above it to obtain the value of each input used per dollar output. Table 22 shows the production coefficients that are calculated from Table 21.

Table 22. Direct inputs per dollar of outputs Region A, 1974.

Industry Producing	Industry Purchasing: Agriculture 1	Manufacturing 2	Trade & services 3	Households 4	Exports 5
1. Agriculture	$.11	$.25	$.18	$.25	$.5
2. Manufacturing	.21	.15	.18	.31	.5
3. Trade & Service	.21	.15	.27	.06	-
4. Households	.31	.25	.09	.25	-
5. Imports	.16	.20	.27	.13	-
6. Total	1.00	1.00	1.00	1.00	1.00

All totals rounded to the nearest cent.

The input-output approach views these production coefficients as constants and uses them to analyze the effect of changes in one sector on the outputs of other sectors and the region as a whole. In fact, however, the set of coefficients may change as output changes. Factors leading to changing coefficients include economies of scale, localization economics (external economies which accrue when like plants agglomerate at one place) and urbanization economies (external economies which result when unlike plants agglomerate at one locality) (Isard, 1960). Other major problems of the input-output approach include classifying and defining the set of industries (or sectors) to be employed, and identifying and distinguishing between flows on current account and those on capital account.

The input-output approach provides all of the information given by an economic base study. The latter may, in fact, be thought of as a special case of the former. (Romanoff, 1974) This study uses the economic base method rather than the input-output approach which requires much more detailed data than the economic base method. Most of the data have to be gathered by extensive survey of each industry's inputs and outputs. Such a survey increases the cost and time requirements of the study. Furthermore, the input-output approach is more applicable to a large region with many economic interrelations and a more complex economy. (Tiebout, 1962) This study, on the other hand, is concerned with a small area where economic activities are relatively small in volume, there is a small industrial base, and the industry whose impact is to be estimated, oil shale, is an export industry.

The Economic Base Method[5]

The economic base method starts by defining the area to be studied: a metropolitan area, a marketing area, a county or any other geographic unit. Next, the economic activities in an area are divided into two sectors, the basic (export sector) and the non-basic (local services sector). The basic sector includes all those industries that export services or goods outside the area's boundaries or alternatively, all those economic activities which are paid for by persons, firms, or organizations outside the area. The non-basic sector (local services activities) includes all those industries that

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[5]More detailed information of economic base methodology and its development is in R. W. Pfouts, The Techniques of Urban Economic Analysis. Chandler-Davis Publishing Co., 1960, and C. W. Tiebout, "The Community Economic Base Study," Supplementary Paper No. 16, Committee for Economic Development, 1962.

sell services or goods for the local market, i.e., goods which are paid for by residents of the area.

The base method posits a positive relationship between basic and non-basic sectors in which non-basic activities are a function of the basic activities. A rise or fall in the basic sector's employment or income will be accompanied by a rise or fall in the non-basic sector's employment or income. The basic sector is considered the determinant factor in the expansion of the economy of an area.

The economic base method recognizes that some industries sell a portion of their services or goods inside the area, and export the rest outside the area. These industries are called "mixed" industries (Tiebout, 1962).

Economic base multiplier

As observed above, basic activities are directly related to exogenous demand, while non-basic activities are indirectly related through the basic (export) activities. Consequently, the total employment (or income) of a region is a function of basic employment (or income) and related to it through the base employment (or income) multiplier. Letting Et = total employment or income

Eb = basic employment or income

En = non-basic employment or income

M = base multiplier,

this can be expressed mathematically as follows:

(1) $Et = M.Eb$

(2) $M = \frac{Et}{Eb}$,

and because Et = Eb + En we can manipulate (2) algebraically:

$$(3)\quad M = \frac{Et}{Eb} = \frac{}{\frac{Eb}{Et}} = \frac{1}{\frac{Et-En}{Et}} = \frac{1}{\frac{Et}{Et} - \frac{En}{Et}} = \frac{1.}{1-\frac{En}{Et}} .$$

When we substitute the last expression in (3) for the multiplier in (1), the economic base equation can be written in the following way:

$$(4)\quad Et = \frac{1}{1 - \frac{En}{Et}} . Eb .$$

The simplest approach for computing the base multiplier is by taking the ratio of total employment to basic employment for any given year, as in equation (2). It derives a homogenous linear estimator. Equation (2) has been criticized for the reason that:

> There is a time lag between the response of the basic sector to a change in exogenous demand and the response of the non-basic sector to the change in the basic sector. (Bendavid, 1974: III).

An alternative calculation of the multiplier in view of the time lag problem may be used when data for the total and the basic employment (or income) are available for two periods of time. Then, a nonhomogenous linear multiplier is estimated by applying the following formula:

$$(5)\quad M = \frac{\Delta Et}{\Delta Eb}$$

This can be used to estimate the change in total employment given a change in basic employment since,

$$(6)\quad \Delta Et = \Delta Et . \frac{\Delta Eb}{\Delta Eb} = \frac{\Delta Et}{\Delta Eb} . \Delta Eb = M . \Delta Eb$$

As an example, a regional employment multiplier value of 3 means that if basic employment in a region increases by one unit, total employment is predicted to increase by three units and non-basic employment to increase by two units.

Classification of basic and non-basic industries

There are four alternative methods used in the economic base method for classifying industries into basic and non-basic industries. These methods are discussed below.

The assumption approach. It is the simplest approach. This approach assumes certain industries are basic industries and that the remaining industries are non-basic industries. It has the weakness of ignoring the fact that some industries sell a portion of their products inside the region and export part of their output outside the region. On the other hand, in small isolated regions the assumption that some industries are basic industries and that the rest are non-basic can be made with certain degree of accuracy. (Bendavid, 1974) An example of this approach is a region with military equipment industry. This industry is a basic industry because all the products are sold outside the region. As another example, agriculture in a small region may be considered to be an export industry, when agricultural products that are consumed locally are a small proportion of the total output.

The location quotient approach. The location quotient approach uses employment in a broader geographical area (perhaps the nation) as its benchmark in dividing industries into basic and non-basic industries. The national location quotient of a given industry is the ratio of the national employment in the industry to total national employment. It assumes that if each region is self-sufficient and has the same economic structure as the nation, and that if the residents of the region have the same demand patterns as the nation, then the

region will have the same ratio of employment in each industry that prevails on the national level.

The regional location quotient of a given industry (i) is the regional employment in industry (i) divided by total regional employment. In order to find if industry (i) in a region is basic or non-basic, divide the regional location quotient by the national location quotient of (i). A ratio that is greater than unity indicates that industry (i) in the region is a basic industry, because the region is more specialized in (i) than the nation. A ratio less than unity indicates that (i) in the region is a non-basic industry.

The location quotient approach has been criticized for its assumption of uniformity in demand and productivity throughout the nation. (Bendavid, 1974; Isard, 1960; Tiebout, 1962) Furthermore, the location quotient approach ignores the fact that a proportion of national output is exported to foreign nations (Bendavid, 1974). A final criticism is that of "product mix". (Tiebout, 1962) Product mix suggests that within any industry many different products are involved. If, for example, a region is specialized in manufacturing run-about motor boats for export, the industry is a basic industry. The problem arises because the run-about motor boat is one of many products produced by the transportation equipment industry. If run-abouts are the only transportation equipment manufactured in the region, and if the regional location quotient is calculated for the transportation equipment industry, the region might appear to be an importer. The location quotient will not show the region's exports of the run-about motor boat, the location quotient will be underestimated. Base employment will be underestimated and the regional multiplier

overestimated. The smaller the region and the more specialized its production, the greater the "product mix" bias is likely to be.

Surveying the local economy. A survey is the most direct method for classifying industries into basic and non-basic industries. Surveys can be done through personal interviews or mailed questionnaires for each industry in the region. The survey may become a very costly and time consuming operation thereby reducing its advantages.

Minimum requirements technique. The minimum requirements approach, which is used in this study, uses a multi-region benchmark. A number of regions similar to the region under study are selected, and for each region the percentage of the labor force employed in each industry is calculated. Employment percentages for each industry for each region are ranked in order of magnitude. The minimum requirements technique assumes that the smallest percentage in a given industry is the minimum requirement in that industry to serve each region's own needs. If a given industry in the region under study has an employment percentage in excess of the minimum requirements level, the excess employment is assumed to be basic employment.

To avoid inclusion of regions that have unusual characteristics, the minimum requirement for each industry is often set at some level higher than the smallest percentage among the benchmark regions. (Tiebout, 1962; Bendavid, 1974) This may be done by averaging a more or less arbitrary number of lowest-ranking percentages and setting this average as the minimum requirement level.

The fact that the minimum requirements technique assumes a uniform production function and demand pattern in both the region under study and its benchmark is one of the problems associated with this

technique.(Tiebout, 1962) Other difficulties include the decisions on how many regions are to be selected for the purpose of comparison and the criteria that will be used in selecting regions similar to the one under study. These problems usually receive arbitrary treatment from the researcher, depending on his experience in economic base studies. (Bendavid, 1974)

Unit of measure

This study utilizes employment data. In principle, there are many alternative units of measure that can be used to calculate regional multipliers. These units include employment, payrolls, value added, value of production, physical production, and dollar income and expenditure accounts for the community. (Pfouts, 1960) Here we will briefly discuss the two most frequently used units of measure - employment and income.

Employment. Employment as a unit of measure has been widely used in economic base studies. The major advantage over other units of measure is that data on employment is usually available for regions by major employment classifications. For purposes of this study, required employment data are available and are reasonably complete and accurate. Another advantage of using employment data is that from an employment multiplier the changes in population and labor force composition can be more readily and directly estimated from than with income data.

There are several difficulties involved in the use of employment as a unit of measure. One is the problem of converting seasonal and part-time employment into equivalent full-time jobs. Another is that employment data treat a job as a job whether it is high-paying or low-paying. Changes in employment in high-paying industries can be

expected to generate more local service employment than changes in low-paying ones. For the most part, these and other problems can be overcome by careful application of conventional statistical and survey techniques, but additional costs are involved in doing so. (Bendavid, 1974)

Income. Income as a unit of measure can be a better indicator of the changes in individual and community welfare than employment. The main problem of using income as a unit of measure is the problem of data availability and reliability, especially in rural regions.

> To be useful for economic base study purposes, income data would have to be available by disaggregated sources. To the extent that such data are available, they are often estimates based on key indicators; reliability is often lowest for rural development regions. (Bendavid, 1974: 107)

CHAPTER IV

THEORY AND METHODOLOGY

In this chapter the procedural framework for the analysis of the impact of a new industry on the economic activities of a small region is discussed. This framework will be utilized to accomplish the main objectives of this study.

This study utilizes the economic base method rather than the input-output method. The reasons for using the economic base method were discussed in Chapter III. The region under study is Uintah County and the new industry is an oil shale production plant. The oil shale industry will be an exporting industry which may effect the entire economic and social activities of the county.

This chapter describes a new method for estimating the regional base multiplier for small areas. Also, it provides a critique of the traditional economic base method and describes how the regional base multiplier developed here tries to maintain the advantages of the traditional economic base method. Employment is used throughout this study. The other serious rival is income. Although each involves problems that have been discussed in the previous chapter, for the purpose of this study, employment data are more revealing. Employment data are easier to obtain by county, and a break-down of employment by major industries is available. As the discussion will show, such a break-down of employment is essential for the practical application and accomplishment of the second objective of this study,

which is to estimate the changes in non-basic employment by industry. Underlying the use of employment is the assumption that a direct relationship exists between changes in the employment and changes in the population of a region. The third objective in this study is to estimate the changes in the total population of the county.

In order to measure the total impact on Uintah County's employment resulting from an oil shale production plant, an employment multiplier has to be estimated for the county. The simplest multiplier is to calculate the ratio of total employment to basic employment for a given year. This multiplier assumes that a linear and proportional relationship exists between total employment and basic employment. This linear relationship is used to project future changes in total employment associated with changes in basic employment. As mentioned in Chapter III, this multiplier may be modified if one rejects the assumption of homogeneity. The modified multiplier assumes that a non-homogenous relationship exists between total employment and basic employment. It can be calculated if data for total employment and basic employment are available for two different periods of time. The estimation of the regional base multiplier is as follows:

$$\text{Base multiplier} = \frac{\text{Change in total employment}}{\text{Change in basic employment}} .$$

If data are available for more than two periods, a multiplier can be estimated by fitting a linear regression line through the points in total employment-basic employment space and the slope of the linear regression line is the multiplier estimate.

Three conceptual problems are associated with using these simple multipliers to project future change in regional employment. The first

problem is that the estimated multiplier "may well be influenced (distorted) by recent changes in basic activities whose multiplier effects have not yet appeared. (Isard, 1960: p. 200) This problem can not be solved by using the ratio of change in total employment to change in basic employment, since a recent change in basic employment may effect one or both ratios. The second problem occurs whether the ratio is based on a given point of time or changes between two points of time. The ratio T/B or $\Delta T/\Delta B$ (T = total employment, B = basic employment) is subject to change because of future changes in social, technological, economic conditions, and locational factors. The third problem is to allocate the projected employment changes to each industry in the non-basic sector. "Regional base analysis pro-rates estimated changes in employment among non-base industries on the basis of industry employment, so that, equal percentage increments are assumed in all industries." (Wiseman, 1974: p. 5)

Figure 2 illustrates this problem associated with regional base analysis. It is assumed that an economy has only two non-basic industries x and y. Employment in the non-base industries is plotted against total employment for past period N_1 and present period N_2 as shown in Figure 2.

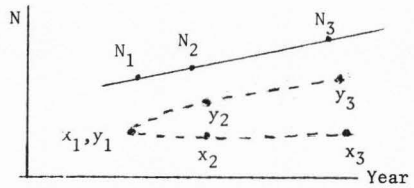

Figure 2. Illustration to the problem of allocation of projected change in total local service employment to each local service industry.

The regional multiplier is calculated by using the ratio

$$\frac{\Delta T}{\Delta B} = \frac{\Delta T}{\Delta T - \Delta N} = \frac{1}{1 - \frac{\Delta T}{\Delta N}} .$$

is equal to one over one minus the reciprocal of the slope of the line segment N_1 N_2 suppose that future non-base is projected to rise in the future to point N_3. The non-base employment in industries x and y are shown in Figure 2. Past employment in x and y were equal, but between past period 1 and present period 2 employment in x declined slightly while employment in y increased. This may be attributed to the relatively greater economies of scale in x than y, changes in demand, technology or location theoretic considerations, one or more of which factors might persist in the future. However, in estimating the future employment in x and y industries as explained above, employment is assumed to rise by the same percentage amounts in both industries to x_3 and y_3 levels as shown in Figure 2. There is an obvious inconsistency in estimating the future employment in non-base industries. Factors leading to non-proportional changes among the non-basic industries are not considered. Thus, the reliability of estimates of future employment in the non-basic industries by the conventional regional base analysis are weakened.

The economic base method that is used in this study represents an attempt to preserve the advantages of this method and at the same time avoid the problem just discussed.

As noted, the economic base method divides the economic activities of a region into two sectors, a basic (export) sector and a non-basic (local services) sector. The basic sector includes all those economic

activities engaged in the export of goods and services outside the region's boundaries. The non-basic sector includes all those economic activities engaged in providing goods and services to the region's local market. The economic base method states that the size and growth of a region's employment is determined by the size and expansion of its basic employment. According to this method, a position functional relationship exists between the size of the basic sector and the non-basic sector. An increase in external demand for the products of a given region would increase the basic employment. Increase in the basic employment would increase the employment in the local services needed to support and to provide goods and services to the employment in the basic sector.

A major issue associated with the economic base method is dividing the region's employment into basic and non-basic sectors. This is a crucial problem which has to be resolved in order to estimate the base employment multiplier. The approaches used in this study to identify basic and non-basic employment are the assumption approach and the minimum requirements technique.

Employment data were gathered by major industries from the Bureau of the Census, Census of Population 1970. The employment data are broken down into 27 industries.

The assumption approach assumes certain industries can be totally classified into basic industries or non-basic industries and the remaining industries are classified mixed industries. The mixed industries are those industries which produce for both the local and the export market. In this study the classification of the 27 industries using the assumption approach are as follows:

I. Basic Industries:

a. Agriculture, forestry, and fisheries
b. Mining
c. Manufacturing
d. Railroads and railway express service

II. Non-Basic Industries:

e. Communications
f. Utilities and sanitary services
g. Banking and credit agencies
h. Insurance, real estate, and other finance
i. Private households

III. Mixed Industries:

j. Construction
k. Trucking services and warehousing
l. Other transportation
m. Wholesale trade
n. Food, bakery, and dairy stores
o. Eating and drinking places
p. General merchandise retailing
q. Motor vehicle retailing and service stations
r. Other retail trade
s. Business and repair services
t. Other personal services
u. Entertainment and recreation services
v. Hospitals
w. Health services, except hospitals
x. Education
y. Welfare, religious, and non-profit membership organizations
z. Legal, engineering, and miscellaneous professional services
aa. Public administration

In order to identify what portion of the mixed industries' employment is basic employment and what portion is non-basic employment, the minimum requirements technique was applied. The minimum requirements technique uses multi-regions as its benchmark. For each region, the percentage of the total labor force employed in each industry is calculated. Then, the percentages for a given industry in the selected regions are ranked in order of magnitude. Finally, the lowest percentage in each industry is considered the minimum requirements level necessary to service local needs. It follows that the

basic employment in the region under study is the sum of employment in excess of the minimum requirements level.

In this study a sample of 197 counties were chosen. These counties have been selected with population ranges of 10,000 to 40,000 persons. The reason for this selection of counties is to span the possibilities for the anticipated population change of Uintah County.

The one hundred-ninety-seven (197) counties were ranked by descending population size and grouped in classes of ten except for the final class which contains only seven counties. Each group of ten counties has approximately the same population. Then, the mean was calculated for the population and employment for the three lowest employment level counties in each group for each mixed industry. This yielded 20 means of population and employment for each mixed industry. An ordinary least squares estimate was obtained for the relationship between population means and the estimated non-base employment means for each mixed industry, using the equation $n^i = b_0^i + b_1^i (P)$ for each mixed industry, to obtain non-basic employment as a function of population.

n^i = non-basic employment in industry (i)

P = population of the county under study

b = coefficients for each industry obtained from the ordinary least squares between population's means and estimated non-basic employment's means.

Similar regressions were run for each of the five non-base industries. In this case it was necessary to make minimum requirements estimates, so the observations consisted of the 197 counties, rather than the 20 group means.

A regional employment and population multiplier was then calculated for Uintah County as follows:

$$\Delta T = \Delta B + \Delta N$$

$$= \Delta B + \frac{\Delta N}{\Delta P} \cdot \frac{\Delta P}{\Delta T} \cdot \Delta T$$

$$= \Delta B + \sum_{i} b_1^i \, (\Delta P/\Delta T)\Delta T$$

$$\Delta T/\Delta B = \frac{1}{1 - (\Delta P/\Delta T) \sum_{i} b_1^i}$$

$$\Delta P/\Delta B = \frac{\Delta P/\Delta T}{1 - (\Delta P/\Delta T) \sum_{i} b_1^i}$$

where:

T = Total employment

B = Basic employment

N = Non-basic employment

P = Total population

b_1^i = Estimated regression coefficient of the i^{th} industry

The regional employment and population multiplier requires the estimation of $\frac{\Delta P}{\Delta T}$. This was estimated in the following way. A sample of 11 counties was chosen from the 197 counties. The population of these counties had grown rapidly between 1960 and 1970. These counties had the highest increase in population among the 197 counties. Next a questionnaire was mailed to the 11 counties, to determine the causes of this rapid growth in population and the year it began. After determining the causes and the year it began, the ratio of population to employment $\frac{\Delta P}{\Delta T}$ for each county was calculated. The rapid growth in population and employment occurred approximately around 1965 in most of the 11 counties.

With the estimated change in P (population) from the previous calculations and the coefficients b_1^i the estimates of changes in local service employment by industry can be calculated. This with current employment levels yields the estimated projected employment for each non-basic industry.

CHAPTER V

RESULTS AND SUMMARY

This chapter shows the results obtained from the ordinary least square estimation procedure and applies these results in the calculation of the regional employment multiplier. It also presents estimated changes in basic and local service employment and population in Uintah County resulting from the hypothesized oil shale development project.

Table 23 shows the coefficients and the T-values for each of the mixed industries obtained from the ordinary least squares regressions described in the previous chapter. Similarly, Table 24 shows the coefficients and T-values for each of the non-base industries.

In order to calculate the regional employment multiplier for Uintah County, the following equation is used:

$$\frac{\Delta T}{\Delta B} = \frac{1}{1 - (\Delta P/\Delta T)\Sigma_i \hat{b}_1^i}$$

Estimating the ratio of $\Delta P/\Delta T$ as described in Chapter IV gave a value close to 2.5. Inserting a 2.5 for $\Delta P/\Delta T$ and .178 for $\Sigma b_1^{i.}$ in the regional employment multiplier equation yields a regional employment multiplier of 1.8.

The labor force that is required to construct and operate the oil shale production plant is shown in Table 25. During the first two years, the oil companies are planning to construct one retort of approximately 14,000 barrels per day capacity. This retort is an

Table 23. Ordinary least square coefficient and T-values for mixed industries estimated from equation $n^i = b_o^i + b_1^i P$

Mixed Industries	b_o^i	b_1^i	T-Values for b_o^i	T-Values for b_1^i
Construction	-51.4195	.0195404	-2.01922	16.6534
Trucking Services and Warehousing	-21.5041	.00327766	-2.3978	7.93179
Other Transportation	-4.76187	.0015607	-1.01144	7.19441
Wholesale Trade	-3.33447	.0052422	-0.19339	6.59830
Food, Bakery and Dairy Stores	-15.1696	.00777941	-1.12317	12.5006
Eating and Drinking Places	17.8089	.00708517	.75162	6.48975
General Merchandise Retailing	-26.7551	.00566333	-5.48068	25.1776
Motor Vehicle Retailing and Service Stations	-4.94746	.00866771	-.37439	14.2353
Other Retail Trade	-42.9512	.0178345	-1.25598	11.3183
Business and Repair Service	-21.8574	.00610569	-1.90575	11.5536
Other Personal Services	-16.8194	.0096024	-1.3108	16.2412
Entertainment and Recreation Services	-3.81412	.00138145	-.71030	5.58342
Hospitals	-3.82197	.00597127	-.14785	5.01336
Health Service, except Hospitals	-28.9205	.00561987	-1.9204	8.09893
Education	-24.2401	.0225388	-1.08564	21.9077

Table 23. (continued)

Mixed Industries	b_o^i	b_1^i	T-Values for b_o^i	T-Values for b_1^i
Welfare, Religion and Non-Profit Membership Organizations	-60.9104	.00672988	-1.95642	4.69129
Legal, Engineering and Miscellaneous Professional Services	-20.0298	.00488081	-2.48764	13.1558
Public Administration	22.1482	.00965559	1.51703	14.3532
$\sum_{i=1}^{18} b_1^i$		-14913684		

Table 24. Ordinary least square coefficients and T-values for non-base industries estimated from equation $n^i = b_o^i + b_1^i P$

Non-Base Industries	b_o^i	b_1^i	T-Values for b_o^i	T-Values for b_1^i
Communications	-8.45263	.00409275	-.98277	10.4327
Utilities and Sanitary Services	30.7804	.00539047	2.51162	9.64198
Banking and Credit Agencies	1.42251	.00457365	-.25113	17.7022
Insurance, Real Estate and other Finance	-38.1368	.00783142	-3.3562	15.110
Private Household	-40.0461	.00891393	2.1577	10.5299
$\sum_{i=19}^{23} b_1^i$		.03080222		

Table 25. Annual direct employment levels: construction and operating employment for oil shale development project in Uintah County.

Year	Construction	Operating	Total
Pre-Commercial Stage			
1	400	---	400
2	400	---	400
3	---	300	300
4	---	300	300
Commercial Stage Phase I			
5	500	300	800
6	1000	300	1300
7	1500	300	1800
8	2000	1500	3500
9	1500	1500	3000
10	500	1500	2000
11	---	2500	2500
12	---	2500	2500
13	---	2500	2500
14	---	2500	2500
Commercial Stage Phase II			
15	---	2500	2500
16	---	2500	2500
17	---	2500	2500
18	---	2500	2500
19	---	2500	2500
20	---	2500	2500

Source: White River Oil Shale Project.

experimental retort which will be operated for two years. Following this initial experimental stage, the oil companies plan to build additional retorts of about the same capacity over a five year period. By the end of the tenth year, the production of oil from shale is estimated to reach a level of 100,000 barrels per day.

For a production level of 100,000 barrels per day, the needed operating force is 2500. The operating labor force will reach the level of 2500 in the eleventh year and stays constant at this level over the next 10 years. Applying the regional employment multiplier of 1.8, the local services employment is estimated to increase by 2,000 employees to provide the needed services to the operating labor force.

There is a time-lag period during which the regional multiplier will take its full effect on employment. Although the basic labor force reaches its peaks in the eighth year and then declines to a constant level by the twelfth year, local service employment is assumed to increase gradually over the 12 year period, and be completely adjusted at the end of the period.

In Figure 3, the straight line shows the estimated increase in local service employment from year one until the end of year 12, at which time employment multiplier takes its full effect and the local service employment is completely adjusted. Also shown is the base employment (Construction and Operating) directly associated with the oil shale industry.

The annual and cumulative increases in local service employment are shown in Table 26. Again the table shows that the local service employment is assumed to increase steadily until it reaches the equilibrium level in the twelfth year, and remains constant thereafter.

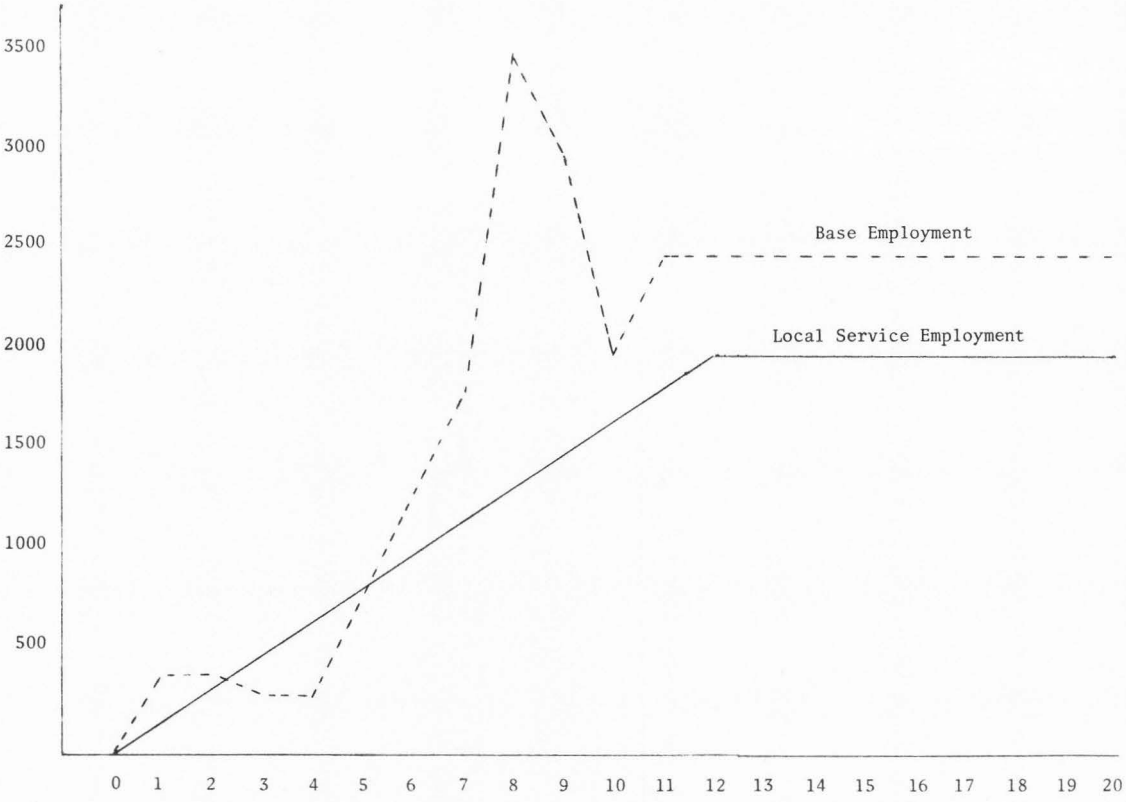

Figure 3: Estimated change in local service employment and base employment (construction and operating) from year 1-20.

Table 26. Estimated cumulative and annual increase in local service employment resulting from oil shale development project in Uintah County for 20 years.

Year	Cumulative increase	Annual increase
1	163	163
2	330	167
3	497	167
4	664	167
5	811	167
6	998	167
7	1165	167
8	1332	167
9	1499	167
10	1666	167
11	1833	167
12	2000	-
13	2000	-
14	2000	-
15	2000	-
16	2000	-
17	2000	-
18	2000	-
19	2000	-
20	2000	-

The estimated increase in employment in each local service industry is calculated using

$$\Delta n_i = \frac{b_1^i}{\Sigma b_1^i} \cdot \Delta N$$

This is derived as follows:

$\Delta n_i = b_1^i \Delta P$ and

$\Delta b_1 = \frac{\Delta N}{\Delta P}$, so that

$$\Delta n_i = b_1^i \Delta P \cdot \frac{\Delta N}{\Delta P} \cdot \frac{1}{\Sigma b_1^i} = \frac{b_1^i}{\Sigma b_1^i} \Delta N$$

For example, for the communications industry, .004 (from Table 24) is divided by .178 (the summation of the b_1^i in Table 23 and Table 24) and multiplied by the 2,000 employees (the equilibrium level of total local service employment from Table 26).

Table 27 shows the estimated increase in local service employment by each industry and after full adjustment to the impact of the oil shale facilities takes place. Table 27 shows the estimated increase in local service employment by each industry at the equilibrium level. The time path of adjustment is not shown, because the growth rates of individual industries are likely to be much more eratic than growth in the aggregate. This study does not attempt to project employment of individual industries for single years.

To estimate the change in population, a regional population multiplier is calculated as described in Chapter IV using

$$\frac{\Delta P}{\Delta B} = \frac{\Delta P/\Delta T}{1 - (\Delta P/\Delta T)\Sigma_i \, b_1^i}$$

The estimated regional population multiplier is 4.5. The 4.5 population multiplier indicates that an increase of one laborer in the base sector results in an increase in population of an additional 3.5 persons. Table 28 is a summary of the construction labor force, operating labor force, change in local service employment, change in total employment and change in population.

Table 28 shows the increase in employment and population. From this the public and the private sector may plan to meet the needs and demands of this increase in the county population. By knowing the

Table 27. Estimated total change in local service employment by industry at the equilibrium level resulting from oil shale development project in Uintah County

Industry	Change in employment
Communications	(.004/.178)(2000) - 45
Utilities and sanitary services	(.005/.178)(2000) = 56
Banking and credit agencies	(.004/.178)(2000) = 45
Insurance, real estate, and other finance	(.008/.178)(2000) = 90
Private household	(.009/.178)(2000) = 101
Construction	(.019/.178)(2000) = 213
Trucking services and warehousing	(.003/.178)(2000) = 34
Other transportation	(.001/.178)(2000) = 11
Wholesale trade	(.005/.178)(2000) = 56
Food bakery and dairy store	(.008/.178)(2000) = 90
Eating and drinking places	(.007/.178)(2000) = 78
General merchandise retailing	(.006/.178)(2000) = 67
Motor vehicle retailing and service stations	(.009/.178)(2000) = 101
Other retail trade	(.018/.178)(2000) = 202
Business and retail service	(.006/.178)(2000) = 67
Other personal service	(.010/.178)(2000) = 112
Entertainment and recreation services	(.001/.178)(2000) = 11
Hospitals	(.006/.178)(2000) = 67
Health services, except hospitals	(.006/.178)(2000) = 67
Education	(.022/.178)(2000) = 247
Welfare, religion and non-profit membership organizations	(.007/.178)(2000) = 78

Table 27. (continued)

Industry	Change in Employment
Legal, engineering, and miscellaneous professional services	(.005/.178)(2000) = 56
Public administration	(.010/.178)(2000) = 112

Table 28. Summary of estimated change in employment and population resulting from oil shale development project in Uintah County for twenty years.

Year	Annual construction force	Annual operating force	Cumulative change in local service	Cumulative change in total employment	Cumulative change in population
1	400	---	163	563	1307
2	400	---	330	733	1832
3	---	300	497	797	1992
4	---	300	664	964	2410
5	500	300	811	1611	4027
6	1000	300	998	2298	5745
7	1500	300	1165	2965	7412
8	2000	1500	1332	4832	12080
9	1500	1500	1499	4499	11247
10	500	1500	1666	3666	9165
11	---	2500	1833	4333	10832
12	---	2500	2000	4500	11250
13	---	2500	2000	4500	11250
14	---	2500	2000	4500	11250
15	---	2500	2000	4500	11250
16	---	2500	2000	4500	11250
17	---	2500	2000	4500	11250
18	---	2500	2000	4500	11250
19	---	2500	2000	4500	11250
20	---	2500	2000	4500	11250

increase in population, the local government can plan to meet the needs of the population for housing and zoning, recreation facilities, schools, hospitals, public utilities and social services.

LITERATURE CITED

Bendavid, Avron, 1974, Regional Economic Analysis for Practitioners, Prager Publishers, New York, New York.

Committee on Interior and Insular Affairs, 1973, Hearings before the Subcommittee on Mines and Mining, Oil Shale Development Part 1, U. S. Government Printing Office, Washington, D. C.

Committee on Interior and Insular Affairs, 1974, Hearings before the Subcommittee on Mines and Mining, Oil Shale Development Part 2, U. S. Government Printing Office, Washington, D. C.

Connery R. H., and R. S. Gilmour (ed.) 1974, The National Energy Problem, E.C. Heath and Company, Lexington, Massachusetts.

Erickson, E. W. and Leonard Waverman (ed.) 1974, The Energy Question: An International Failure of Policy, Vol. 2, University of Toronto Press, Toronto.

Goodwin, Irwin (ed.) 1974, Energy and Environment: A Collision of Crises. Publishing Sciences Group, Inc., Acton, Massachusetts.

Isard, W., 1960, Methods of Regional Analysis: An Introduction to Regional Science, Wiley and Sons Publishers, New York, New York.

Mancke, R. B., 1974, The Failure of U. S. Energy Policy, Columbia University Press, New York, New York.

Mead, W. J., 1975 "An Overview of Energy and Energy Related Research in the West," University of California, Santa Barbara, California.

Miernyk, W. H., 1957, A Primer of Input-Output Economics, Northeastern University, Boston, Massachusetts.

Needleman, L., 1968, Regional Analysis, Penguin Education, Baltimore, Maryland.

Park, S., 1970, "Least Squares Estimates of the Regional Employment Multiplier: An Appraisal," Journal of Regional Science, Vol. 10 pp. 365-74.

Pfouts, R. W., 1960 (ed.) The Techniques of Urban Economic Analysis. Chandler-Davis Publishing Company, West Trenton, New Jersey.

Richardson, Harry, 1969, Regional Economics, Prager Publishers, New York, New York.

Siegel, R. A., 1966 "The Economic Base and Multiplier Analysis," Urban Affairs Quarterly, II pp. 24-38.

Tiebout, Charles, 1962, The Community Economic Base Study, Committee for Economic Development, New York.

Ullman, E. L. and Michael Dacey, 1960, "The Minimum Requirements Approach to the Urban Economic Base." Papers and Proceedings of the Regional Science Association, Vol. 6, pp. 175-94.

United States Department of the Interior, Bureau of Land Management, 1973, Final Environmental Statement for the Prototype Oil Shale Leasing Program, Vol III, U. S. Government Printing Office, Washington, D. C.

Weiss, S. J. and E. C. Gooding, 1968, "Estimation of Differential Employment Multipliers in a Small Regional Economy," Land Economics, Vol 44, pp. 235-44.

Wiseman, Clark, 1974, "Regional Multipliers and Resource Development Impacts in Small Areas," Utah State University, Logan, Utah.

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