THE ECONOMY OF ALBANY, CARBON, AND SWEETWATER COUNTIES, WYOMING DESCRIPTION AND ANALYSIS

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CHAPTER 1

INTRODUCTION

The purpose of this report is to provide a description and analysis
of a regional economy within the State of Wyoming. The intent of the re-
searchers is to provide policy makers with specific information contributing
to the decision-making and planning processes and to provide a planning tool
having the capability of analyzing a number of alternative development
scenarios in the study region.

THE REGION UNDER STUDY

The study area consists of three counties of southern Wyoming:
Sweetwater, Carbon, and Albany. These counties encompass an area of
approximately 25,000 square miles and account for nearly 23.5 percent of
the total land area of Wyoming. About 56.3 percent of the region's total
land area is owned by the federal government.[1] The region's 1975 population
is estimated at 73,549 inhabitants with a personal income of over $2 million.
Both the population and the personal income of the region make up about 19.5
percent of state totals.[2] Almost 32 percent of Wyoming's mining employment
occurs in the study area. Well over 70 percent of the region's exports
are in the sectors: coal, other mining, oil and gas production, or

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[1]Private land ownership varies considerably among the three counties.
Almost 65 percent of the 2,799,575 acres comprising Albany County is pri-
vately held, while only 39.4 percent of the 5,047,785 acres in Carbon
County is private, and 27 percent of the 6,749,348 acres in Sweetwater
County is private.

[2]Wyoming Department of Administration and Fiscal Control, Wyoming Data
Handbook, 1977, pp. 69-72, 81-84, 141-44.

electricity (which is generated from local coal deposits). Agricultural production, which is mainly livestock, accounts for about 7 percent of the region's exports. Big game hunting, fishing, and winter recreation are also important in the region. The region contains a major transportation corridor with significant sales related to railroad and highway shipping. The regional economy is also characterized by a small base in light manufacturing which makes up about 6 percent of exports. However, the region imports nearly all finished consumer products, heavy industry products, and most ingredient materials.

The southern Wyoming topography consists mainly of high plateaus, which are in actuality structural ba'sins with an altitude ranging from 6,500 to 7,500 feet. The area has a semiarid climate causing deflation hollows, alkali flats, playas, and sand and silt dunes. The Green River basin occupies the western part of the area, separated from the Great Divide basin to the east by the Rock Springs anticline. The Great Divide basin is further divided into the Washakie basin to the south and the Red Desert basin to the north. The Rawlins Uplift and the Sierra Madre-Medicine Bow Mountains complex separate the Hanna-Laramie basins from the Great Divide basin. These basins are bounded to the east by the Laramie Mountains, and to the north by the Wind River Mountains and the Sweetwater Uplift.

The topography, in turn, controls much of the climate, with temperature and precipitation being controlled by elevation, and the central continental location. As the elevation becomes lower, the amount of precipitation drops. The areas receiving less than 8 inches of precipitation have very sparse vegetation and are classed as semidesert. The areas receiving between 8 to 16 inches of rain per year support some trees. This area of

Wyoming tends to have dry summers. Prevailing winds, for the most part, are out of the southwest. The wind patterns are frequently affected by the mountain structures, giving localized weather. The wintertime relative humidity of the area is 20 to 40 percent. The winter winds out of the north typically bring cold dry air with speeds often exceeding 45 miles per hour. The mean annual precipitation is less than 8 inches per year in the Rock Springs area, and the Great Divide basin, to between 8 to 16 inches elsewhere in the study area. The mean annual frost-free days is less than 90 days for the majority of the area. The mean January temperature for the majority of the area is from 10 to 20 degrees, and for July the mean temperature is between 60 to 70 degrees F.

This topographic and climatologic regime dictates the vegetation to be mostly sagebrush and grass. Included in the Green River basin is more saltbrush greasewood, indicating salt near the surface. There is also some montane coniferous forests represented by inland Douglas fir.

The area is very rich in mineral resources, including coal, uranium, trona, oil shale, oil, and gas. All of these minerals are stratigraphically controlled. Coal, for example, has been classified according to its geographical area. The Green River basin has been categorized as a coal province, with coal bearing rocks within the basin being the Mesaverde group and the Lance of Late Cretaceous age, the Fort Union of Paleocene age, and the Wasatch formation of Eocene age. The coal beds range in thickness from a few inches to 42 feet and in rank from subbituminous to high-volatile bituminous C. The coals with the higher rank are found associated with intense structural deformation and igneous intrusives. The coal beds interior to the basin are nearly horizontal, and dip sharply around the Rock Springs anticline, and the basin margins. Within the Green River coal province, the Mesaverde group has been the most extensively mined.

But several hundred million tons of strippable Fort Union and Wasatch coal is presently being developed and mined for thermal power generation. For the most part, coal beds lie too deeply buried in the basins to be of economic interest.

To the east, the Hanna Coal Field is a structurally downwarped area separated from the Green River basin by the Rock Springs uplift, and the Rawlins Hills, and is bounded on the north and south by mountains. To the east, it merges with the Laramie basin. Within this basin complex, a total of 130 coal beds has been mapped in the coal bearing Mesaverde and Medicine Bow Formation of Late Cretaceous age, the Ferris Formation of Late Cretaceous and Paleocene age, and the Hanna Formation of Eocene age. The coal beds are subbituminous C to high-volatile bituminous C in rank and range as thick as 8 feet in discontinuous beds in the lower formations to as thick as 35 feet in the Hanna Formation. The Hanna basin area is characterized by rugged surface features and steep dips ranging from 10 to 25 degrees in the areas of thick coal outcrops.

The Rock Creek Coal Field adjoins the Hanna basin field on the southeast and contains coal beds ranging as thick as 9.5 feet in the Hanna Formation and about 8 feet in the Mesaverde. Large areas of the surface are covered by gravel and the coal bearing rocks are difficult to mine or even map.

Occurrence of oil and gas in the study area is also tied quite closely to the locations of the sediment-filled basins. Wyoming's oil and gas normally occur in either structure-controlled or stratigraphy-controlled concentrations. Because of the differences in specific gravity, gas is found at the top of the trap, oil below, and water beneath the oil. Because of the obvious surface expressions of structural traps, crests of upwarped

COAL RESERVES WITHIN STUDY AREA

Major Coal Basin	Estimated Original Reserves[*]
Green River Coal Region	15,955,880,000 tons
Hanna Coal Rield	3,916,960,000 tons
Rock Creek Coal Field	305,180,000 tons

Strip Mine Deposits	Strippable Resources[**]
Jim Bridger Coal Deposit (Deadman Seams)	250,000,000 tons
Black Buttes Coal Deposit (Wasatch, Lance, Fort Union Formations)	82,600,000 tons
Red Desert Coal Deposit (Wasatch Formation)	733,100,000 tons
Cherokee Coal Deposit (B and C Coals)	200,900,000 tons
Hanna and Ferris Formation	313,000,000 tons

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[*] Estimated original resources (short tons with less than 3,000 feet over-burden, USGS Circ. 81, 1950.

[**] Strippable resources in short tons (modified from the USBM IC 8538, 1972.

or anticlinal rock were often the targets of early exploration. Only deeply buried structural traps, or stratigraphic traps (i.e., traps in which the oil and gas are concentrated by a decrease in porosity in updip direction, thus stopping the migration of oil and gas) remain to be found. Industry now relies on new high resolution seismic techniques, to locate the more subtle traps. Reservoir rock ranges in age from Tertiary to Cambrian and is most often composed of various types of porous sandstone or limestone. In general, fields in stable interior basin areas are characterized by stratigraphic traps which produce from Tertiary and

Cretaceous reservoirs. Conversely, those in the deformed margins of the basins are characterized predominately by structural traps. Drilling activity can be broken down into development drilling (drilling to expand production within a known field) and exploration or wildcat drilling (drilling to find new production).

SUMMARY OF DRILLING ACTIVITY
FROM 1971 TO 1977 IN STUDY AREA

	Green River Basin:		Laramie-Hanna Basin:	
	Total Wells	New Field Wildcats	Total Wells*	New Field Wildcats
1977	294 23%	0 oil 38 gas	19 1%	0 oil 0 gas
1976	175 18%	3 oil 14 gas	8 1%	0 oil 0 gas
1975	169 13%	1 oil 10 gas	6 0.5%	0 oil 0 gas
1974	131 13%	1 oil 6 gas	17 2%	0 oil 0 gas
1973	138 16%	1 oil 8 gas	4 0.5%	0 oil 0 gas
1972	121 13%	0 oil 12 gas	11 1%	0 oil 0 gas
1971	117 13%	0 oil 3 gas	10 1%	0 oil 0 gas

*% is the percent of total wells drilled in Wyoming.

Source: Barlow and Haum, Inc., Geologists, Oil and Gas Production, Reserves, and Resources in Wyoming, 1978.

RESERVES AND RESOURCES FOR OIL AND GAS*

	Estimated Cumulative to 01/78	Estimated Remaining Reserves	Estimated Undiscovered Resources
Green River Basin:			
Oil bbl	419,183,047 9.4%	604,380,000 33.2%	140,000,000 to 718,000,000 (range) 312,000,000 (most likely)
Gas mcf	2,946,668,604 40.6%	5,907,120,000 60.4%	9,910,000,000 to 47,430,000,000 (range) 22,000,000,000 (most likely)
Hanna-Laramie Basin:			
Oil bbl	68,361,038 1.54%	7,052,147 .4%	50,000 to 200,000 (range) 110,000 (most likely)
Gas mcf	89,550,277 1.23%	1,178,728 .01%	65,000 to 2,600,000 (range) 1,430,000 (most likely)

*% is the percentage of total Wyoming base figure.

Source: Barlow and Haum, Inc., Geologists, Oil and Gas Production, Reserves, and Resources in Wyoming, 1978.

Uranium districts within the study area are: Red Desert, Crooks Gap,

and Green Mountain, and Shirley Basin. The major uranium deposits are con-

centrated within sedimentary rock along roll fronts. In vertical cross-section,

a roll front appears as a C-shaped interface between oxidized and reduced portions of sandstone, with the uranium concentrated along the boundary. The uranium was leached from its original source rocks, and carried in solution by acidic water, until the aqueous solution is reduced.

Uranium is used primarily for nuclear reactors and in the national defense program. In the U.S., Wyoming ranks second only to New Mexico in uranium production and reserves.

URANIUM RESERVES (ESTIMATED) FOR SELECTED WYOMING BASINS

District	Lbs. of $U_3O_8 (\times 10^6)$
Shirley Basin	100
Crooks Gap - Red Desert Basin	30

Source: DOE (1976), National Uranium Resource Evaluation, Preliminary Report.

The major units where uranium favorability is high are: Eocene Wind River formation in the Shirley Basin; the Eocene Battle Springs and Wasatch formation in the Wahake and Rock Springs basins. The Laramie-Hanna basin has Eocene Wind River, Cretaceous Cloverly, and Jurassic Morrison formations.

Trona is a mineral that has a major economic importance to the study area. Dollar value of Wyoming's trona industry was estimated in 1977 as 340 million dollars, second only to the total petroleum industry. Presently four companies operate underground trona mines in Sweetwater County. Allied Chemical Corporation, FMC Corporation, Stauffer Chemical Company, and Texas Gulf, Incorporated, employ more than 3,000 workers. The primary users of the trona are the glass manufacturers in Indiana and Ohio. The future demand for this mineral looks good, and the resources of the mineral are vast.

The USGS estimated that 42 beds in the Wilkins Peak Member of the Green River formation may contain as much as 100 billion tons of trona (University of Wyoming Contribution to Geology, 1971).

Within the same Green River formation, vast quantities of untapped oil shale exists, the USGS estimated 320 billion barrels in rock of 15 gallons per ton (USGS Prof. Paper 820, 1973), yet this can be considered a resource of the future. Development of Wyoming's oil shale appears to be many years in the future, with industry concentrating on making the richer Colorado oil shale of 25-65 gallons per ton profitable. Rock Springs has for experimentation, a Department of Energy in situ oil shale retorting and fracturing site.

To handle this large mineral sector within the tri-county area, an infrastructure of pipelines, roads, and rail service has been created. Major natural gas pipelines in the area are:

. The Northwest Pipeline Corporations' 22-inch line to the Pacific Northwest.

. Mountain Fuel Supply's 20-inch and two 18-inch lines to Salt Lake City.

. Colorado Interstate Gas Company's 24-inch and 22-inch line to Denver and east.

. FMC Corporations' 10-inch intrastate line for its trona plant.

. Stauffer Chemical Corporation's 10-inch intrastate line for its trona plant.

Other transportation networks are the high tension powerlines from the 2,000 MW Jim Bridger Power Plant for Pacific Power and Light and Idaho Power Co., the Union Pacific Railroad, and Interstate 80.

The rapid growth of the population of southern Wyoming has been caused by the fast expansion of the mining sector. The expansion of the mining industry is reflected by the employment figures for Carbon and Sweetwater counties.

EMPLOYMENT IN MINING INDUSTRY

County	Year											
	68**	69**	70**	71**	72**	73**	74**	75**	78***	79***	80***	81
Albany	D	D	D	D	D	D	D	51	32	32	32	
Carbon	520	565	750	843	1014	1141	1327	1506	1764	2257	2514	26
Sweetwater	1304	1465	1609	1669	2012	2488	3280	4263	5846	6451	6704	70

**Wyoming Handbook, 1977.
***Wyoming Population and Employment Forecast Report, 1979.

This expansion of the mining sector has effects on the estimated amount of population within the tri-county study area.

POPULATION MEASURED AND ESTIMATED

County	City	Year			
		1970*	1975**	1980***	1988***
Albany		26,431	26,660	31,350	39,241
	Laramie	23,143	23,421		
Carbon		13,354	16,745	22,545	30,016
	Rawlins	7,855	9,592		
Sweetwater		18,391	30,144	40,301	50,441
	Rock Springs	11,657	17,773		
	Green River	4,196	7,423		

*1970 U. S. Census.
**Wyoming Handbook, 1977.
***Wyoming Population and Employment Forecast Report, 1979.

STATEMENT OF THE PROBLEM

The natural resource base in the region, while relatively abundant in terms of the capability to satisfy local demands, is nonetheless the focal

point for regional and extra-regional economic conflict. Ownership of the
large deposits of exploitable resources is vested largely with the Federal
Government and corporations headquartered out of state. Thus, from a re-
gional perspective, policies affecting the disposition of the regional
resource base are largely determined outside of the region. From this same
perspective, there is a need to develop a detailed description of the eco-
nomy as it presently exists and an analytical framework which is capable
of assessing the direct and indirect consequences of alternative scenarios
for resource exploitation proposed by the public and private sectors of the
economy. This description and analysis constitutes the major thrust of the
research reported here.

THE MODEL USED

A tool particularly adapted to these questions is the comprehensive
interindustry production model developed by W. W. Leontief. The strength
of this model (often termed the input-output model) lies in its capability
not only to describe the interdependence existing among sectors of an eco-
nomy but also in the capacity to demonstrate, sector by sector, the total
consequences of any number of development scenarios. The model is thus both
descriptive and analytical. The descriptive components are accommodated
through the collection of extensive primary data, from firms within the
region, and subsequent tabulation of the data in a form required by the
interindustry framework. The analytical phase consists of the impact anal-
ysis, development of the various multipliers, and consistent forecasting
under alternative resource development scenarios.

OUTLINE OF THE REPORT

The remainder of the report consists of a description of the method of
the study which is presented in Chapter 2; the analysis of the regional

economy, which is the concern of Chapter 3; and an extension of the basic model to include an analysis of water use which is contained in Chapter 4.

In addition to the main text of the report, there are several appendices. These contain the sector definitions, the input-output tables, the survey form and a bibliography.

CHAPTER 2

THE METHODOLOGY OF THE STUDY

INTRODUCTION

The national energy and minerals situation has focused an increasing attention on the natural resources in the tri-county region of southern Wyoming. The exploration, development, and extraction activities associated with these natural resources have generally been viewed as isolated from, or independent of, the remainder of the economic environment. While it is not proposed to perform an ex-post evaluation of the impacts of existing developments, a major product of this research is the provision of the analytical capability for assessing the regional impacts of continued resource developments.

The interindustry model identifies the interdependent structure of an economy. No producing sector is autonomous (independent of the other sectors); rather, each sector interacts with other sectors (industrial, commercial, labor, government) through the purchases of goods and services and the sale of outputs. Structural interdependence means, quite simply, that the activities of one sector have impacts on others. The identification of the nature and magnitude of this interdependence is one of the most useful results of the interindustry model.

The model is driven by what are termed final demands.[1] Final demands (as opposed to intermediate demands) reflect the demand for goods and services in final form. Thus, final demand sectors use or consume a finished

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[1] See Chapter 3 for a more complete explanation of the interindustry model.

good. Intermediate demands, on the other hand, reflect the demand for goods and services which are processed before becoming available for final consumption. Thus, changes in final demands result in changes in the processing (or intermediate) sectors of the economy. The primary purpose of the interindustry model is to trace these impacts throughout the economy. Tracing these direct and indirect impacts allows the derivation of the multiplier effects on production, income, employment, or water use, and also allows the use of the model in providing consistent forecasts of economic activity.[2]

PROCEDURES FOLLOWED

The discussion of procedures followed in conducting the research may be conveniently condensed into several categories including: the definition of the region, delineation of economic sectors, the data collection effort, selection of the base year, and data processing. Each is discussed, as briefly as possible, in the following pages.

DEFINITION OF THE REGION

The tri-county region of southern Wyoming, for purposes of this study, was defined as Albany, Carbon, and Sweetwater counties. This regional definition allows for an analysis of an area most immediately impacted by actual and potential coal, uranium, and trona development.

SECTOR DELINEATIONS

The interindustry model requires the separation of the economy into various economic entities or "sectors." Total output, by interindustry

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[2] The projections are consistent but the underlying assumption in the model of fixed production coefficients qualify the results unless some dynamic adjustment of technology is explicitly involved.

accounting procedures, is the aggregate value of all sales or purchases that take place, i.e., the total sales or purchases during a year. This total output must be divided up into sectors in order to assess the interindustry structural dependence that prevails. The model structures economic activity into two major components, suppliers (or sellers) and purchasers (or users). Each of these is further subdivided according to the following scheme: Suppliers include: 1) intermediate or processing suppliers who are producers who must purchase inputs to be processed into output which they sell to final users or as inputs to other processors; and 2) primary suppliers whose output is not directly dependent on purchased inputs. This latter category includes non-local suppliers (or imports). Purchasers include: 1) intermediate or processing purchasers who buy the outputs of suppliers for use as inputs for further processing; and 2) final purchasers who buy the outputs of suppliers in their final form and for final use. This latter category includes purchases by non-local users (or sales to exports). The level of demand by final purchasers, and its composition, are determined outside the processing sector. Production to meet the exogenously determined final demands generates intermediate purchases and sales. Primary suppliers and final purchasers may or may not be one and the same. However, in the interindustry model, their activities are treated as if they were completely independent of one another.

In summary, the two major divisions of suppliers are the intermediate suppliers, which are called the processing sector, and the primary suppliers, which are referred to as the final payments sector. (The suppliers are conventionally shown along the left border of an interindustry table.) The two major divisions of the purchasers are the intermediate purchasers, which are labeled as the processing sector (just as with the intermediate suppliers)

and the final purchasers which are labeled final demand. (The purchasers are conventionally shown along the top of an interindustry or input-output table.) It is within this general framework that a further sector disaggregation must be accomplished.

The ideal sector delineation would allow unique recognition of industries or producer groups which provide a homogenous good or service. This ideal is very difficult to achieve because of the large amounts of time and finances required for detailed disaggregation, disclosure problems, and lack of data. Any of these factors or a combination of them lead to a violation of the homogenous product ideal.[3]

Sector selection, in addition to dependence upon financing, time, and data availability, is determined to a large extent by the objectives of the study. Research objectives can often be achieved without detailed disaggregation in all sectors. Since the purpose here is largely to determine the impacts of coal development and other sectors such as uranium, trona, agriculture, and local government, economic sectors such as trade and services do not require detailed disaggregation. The final delineation of the sectoring plan adopted for this study is shown in Table 2-1. A discussion of the two non-conventional accounting device sectors and how they are used follows. These sectors are the local and county taxes account and the transfer account. There is also an explanation of the profit and depreciation sectors.

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[3]Information obtained from the Wyoming Employment Security Commission cannot be published unless there are at least three firms in a given sector and no two firms account for more than 30 percent of the total employment. Ethical considerations also dictate that the operations of any single enterprise can never be divulged.

The local and county government tax sector is employed as an accounting device, including all building permit fees, franchise taxes, local and county liquor license fees, charges for services, intergovernmental transfers, and fines and forfeitures. All revenues accruing to local and county government entities are shown as being paid to this account (sector). In turn the account distributes the tax monies to the appropriate agencies.

Thus, the entries in the row for the local and county government tax sector show the amounts of local taxes and other charges paid by each respective sector in the tri-county economy. In turn, the column entries in the local tax account distribute monies for health, education, social services, roads and bridges operation and maintenance, other general government activities, and otherwise unallocated bond indenture sinking funds.

Another accounting device employed in the tri-county interindustry model is the transfer sector. This accounting device allows for two unique and distinctive characteristics that are not usually found in other regional interindustry studies. First, the assumption that transfer payments cancel in the net is dropped. Second, the model handles financial balances in such a manner as to give rise to a definition of regional income more analogous to the definition of national income. There are several reasons for this. (The reader is referred to the gross flows in the appendix for the positioning of the transfer sector and the relative magnitudes of its row and column values.)

First, insurance premiums were divided so that a value equal to loss experiences ($20,570,200) was separated from other revenues ($8,567,400). This value equal to loss experiences was the prorated among the various sectors in accordance with their premium payments and directly charged into the transfer row. Thus, the $20,570,200 loss experience is not part of the total

TABLE 2-1

SECTOR IDENTIFICATION, TRI-COUNTY REGION
OF SOUTHERN WYOMING, 1977

Sector Number	Sector Description	1972 SIC Codes
Processing Sectors		
1.	Ag/Livestock	02,07,08
2.	Coal Mines	12
3.	Mines, NEC	10,14(less 14
4.	Oil/Gas Production	13
5.	Construction	144,15,16,17
6.	All Manufacturing	20,23,24,25,2 27,28,29,31,3 33,34,35,38,3
7.	Transportation/Communication	40,41,42,44,4 46,47,48
8.	Electricity ; Gas Utilities	491,492
9.	Whoesale Trade	50,51
10.	Retail Trade	52,53,54,55,5 57,58,59
11.	Finance, Insurance, Real Estate	60,61,62,63,6 65,66
12.	Services, NEC	70,72,73,75,7 78,79,81,83,8 86,88,89
13.	Medical Services	80
14.	Education	82
15.	Water, Sewerage, Trash Removal Services	495,497
16.	Local and County Roads	-
17.	Local and County Government	91,92,93,94,9 96

(partial text visible in right margin:)
Sector
Number

18.   L

19.   S

Final De

20.   H

21.   S

22.   F

23.   T

24.   E

25.   C

26.   E

27.   E

28.   T

TABLE 2-1 (Continued)

Sector Number	Sector Description	1972 SIC Codes
18.	Local and County Tax Accounts	-
19.	Subtotals	
Final Demand Sectors		
20.	Households	-
21.	State of Wyoming	91,92,93,94,95, 96,97
22.	Federal Government	91,92,93,94,95, 96,97
23.	Transfer Account	-
24.	Economic Investment	-
25.	Oil R and D	-
26.	Exports to Wyoming Other Than the Tri-County Region	-
27.	Exports to the Rest of the World	-
28.	Totals	

gross output of the insurance and real estate sector. The transfer column in turn is shown as making the claim payments to the various sectors, construction ($925,907), retail trade ($252,729), health medical care services ($10,324,244), services N.E.C. ($5,116,011), households ($3,279,775), and imports ($671,534).

Second, the State of Wyoming generated revenues in the tri-county region of southern Wyoming that exceeded the value of the state's expenditures in the region. This financial surplus is shown as an outlay by the state sector to the transfer account row. The transfer column then shows the State of Wyoming's financial surplus ($14,252,517) as an import from Wyoming other than the tri-county region. Similarly, the federal government generated a surplus of $99,179,994 in the tri-county region. The accounting for this was to have the federal government column charge the surplus to the transfer row. In turn, the transfer column charges the amount of the surplus to the imports from the world row. Thus, the federal government's financial surplus is removed from the region.

Third, transfer payments to households are handled through the transfer account.[4] Taxes collected in the region are always shown as being paid to the respective government accounts, i.e., local and county tax accounts, State of Wyoming, or federal government. Any inter-governmental transfer is shown as a sale by the recipient and a purchase by the grantor. In turn,

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[4] At the county and state levels these transfer payments are monies distributed for social services, to unemployment compensation insurance claims and pensions. Federal government transfer payments include bonus payments under the food stamp program, direct payments to households under the social security program, such as disability, retirement, and survivor benefits, railroad retirement benefits, black lung benefits, veterans and military pensions, federal employee retirement benefits, and medicare payments.

the account that grants the transfer payment(s) to the household sector is shown as making a purchase from the transfer account row in the amount of the transfer payment(s).[5] The transfer account column then makes the payment to the household account. The total of the transfer payments in the tri-county region was $78,039,879.

Fourth, financial capital finds its way into the tri-county region by means other than local financial institutions.[6] When interest payments are made on this outside finance, the dollars involved leave the region; a lower bound estimate for this phenomenon was $54,556,109 for interest paid to out of region accounts. To account for this, the total gross output of the regional financial institutions was increased by $54,556,109 so that all interest payments in the region could be shown as being made to the finance sector. The finance sector then charged the transfer row with the amount of the increase and the transfer column charged the same to the imports from Wyoming other than the tri-county region.

Fifth, interest paid by local financial institutions ($15,023,245) on savings accounts and certificates of deposit was charged against the transfer account row. The transfer account column distributed this interest to the profit and rents row entry.

The transfer account was used to close profits, interest, rents, and the like into the household sector. To accomplish this, the transfer account column was given a $43,623,746 credit at the intersection with the profit sector while the same amount is charged at the intersection with the household

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[5] Respectively, for the accounts local and county governments, State of Wyoming, and federal government these charges are $449,898, $3,970,465, and $73,619,516.

[6] An example would be the sale of bonds in an open market by a school district.

row.

Finally, the transfer account row was used to export the region's net capital shortage, mineral research and development, and dividends paid to area residents by out-of-the-region firms. The value of these export transactions was $52,003,979. The transfer account row in turn charged these amounts to the profits row.

Where enterprise accounting was employed, the profit sector includes after-tax profits, charges to reserves for bad debts, capital loss amortization, and outlays for rents and royalties.[7] Where government fund accounting was employed, the profit sector includes surplus of current revenues over current[8] expenditures[9], the value of capital expenditures appropriated out of current revenues, contributions to bond indenture sinking funds out of current revenues, net charges out of current revenues to any other reserve fund (e.g., contingency funds), and rent payments.

The depreciation sector includes both depreciation and net inventory depletions. Inventory depletions are, relatively speaking, insignificant and are placed with depreciation charges. Similarly, the net inventory accumulation values were incorporated in the investment sector.

With the exception of the intersection of the household row and the transfer column and the household on household cell, the household row

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[7] Except in the case where rents (e.g., agricultural land leases) and royalties (e.g., oil and gas) were paid to the Wyoming and federal governments. In these instances the amounts are shown as being paid directly to the respective governments.

[8] Current in the sense that it occurred in 1978.

[9] An exception to this is in the Wyoming and federal government sectors; see the explanation of the transfer section.

represents wages and salaries paid subject to withholding. In the absence of an adequate source for domestic employment earnings, 329 employees are assumed to be full-time equivalents at $3.10 an hour for 2,000 hours.

QUESTIONNAIRE DESIGN AND USE

Previous experience with questionnaires employed to obtain primary information for interindustry models suggested that a questionnaire, as such, should not be used in the pursuit of the primary data. The reason behind this is that no firm accounts for expenditure and revenue patterns on an SIC basis, the language ultimately employed in an interindustry model. Rather, a firm's books are designed around process or product activities. The use of a questionnaire, either by mail or by interview, presupposes adequate translation from a firm's accounting language into SIC codes. The typical entrepreneur or manager does not ordinarily work with SIC descriptions, a rather precise and technical language.

Accordingly, a determination was made to conduct all interviews in a basic accounting language tailored to the individual firms involved and for the researcher to make the translation to SIC classification. Thus, the questionnaire form which appears in the appendix represents the format for the final translation by the researcher. A large majority of the primary data were originally collected in field notes that described the detail behind profit and loss statements for the firms interviewed.

Not all interviews could, however, be conducted as planned. It was found, for example, that some firms would have to refer for legal advice while others did not want to reveal information in the form desired. Even though it was established that the research should not solicit primary data through the mail, it was necessary to design a questionnaire for use both

as an interview focal point and as an item that could be left with an inter-
viewed firm.

The questionnaire was designed to fit three sheets of paper. A cover
sheet was used to briefly explain the nature of the research and to solicit
information on the nature of the firm's product lines, the number of employ-
ees, water use, and level of capacity utilization. Outlay patterns, both of
a cash flow and a non-cash flow nature, were the concern of the second sheet;
information on sales distribution was solicited on the third. Both sales
and outlay patterns were disaggregated by tri-county interindustry study sec-
tor descriptions and regionalized according to (a) tri-county, (b) Wyoming
other than the tri-county region, and (c) activity outside Wyoming. A ques-
tion on water use was included to provide information on sector-by-sector
water withdrawals. The level of production capacity utilization question was
used to provide general background information.

SELECTION OF THE BASE YEAR

There is no price index constructed specifically for Wyoming. This ef-
fectively removes one criterion (relatively stable prices) from consideration
when selecting a base year for Wyoming economic studies. The 1978 base was
selected for the initial survey for the following two reasons.

Interviewing for the tri-county interindustry study began in August,
1979. Calendar 1978 was the most recently completed accounting cycle for
most firms; it was anticipated that the information from this cycle would be,
qualitatively speaking, foremost in the command of the interviewees. Also,
activities of relatively new firms were automatically incorporated in the
primary data base by soliciting what was then the most current information.

CONDUCT OF THE SURVEY

Interview schedules were arranged by telephone between three days and a week in advance. Every effort was made to gain an interview with the person who would have immediate authority to release information. The length of time spent on an individual interview varied from firm to firm. Several were conducted in less than an hour; some took place over several days. The survey process continued over a two-month period.

PROCESSING THE DATA

Information gathered on the outlay and sales patterns for any given enterprise was tabulated to conform to the sector delineations and regional descriptions as defined in Table 2-1. Care was exercised at this step to assure a balance between outlays and sales. Any anomalies were checked and corrected before proceeding further.

The next step was to aggregate questionnaire forms within a sector and to expand the information to represent gross flows. An iterative process was used to accomplish this so that the relative composition of a given sector delineated for the tri-county interindustry model would be more truly reflected.[10] The final iteration produced gross flow patterns for the

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[10] For example: There were three two-digit SIC classifications incorporated in the sector delineation for construction. Accordingly the questionnaire forms were first aggregated on the basis of the two-digit categories. Regional payroll data from the Wyoming Employment Security Commission were then aggregated on the same basis. The payroll values on the aggregated questionnaire forms represented a given proportion of the regional payroll in each respective SIC classification; based on this ratio the information on the aggregated two-digit level questionnaire sheets was blown up to represent the total pattern for the two-digit delineation. Subsequently, the computed totals at the two-digit level were aggregated to represent the construction sector in the tri-county Wyoming interindustry model.

respective sectors delineated in the model.[11] The gross flows identified in this manner provide the border totals for the initial transactions statement.

Reconciling discrepancies in any given transaction cell is to be expected; only if the research yielded perfect knowledge about outlays and sales would this be avoided. A discrepancy can emanate from one of several sources or a combination thereof. The sales or purchases of one industry to or from another industry can be misrepresented, or the total gross output value for individual sectors can be in error. In the former case other rows and columns are affected by the error. In the latter, there is an aggregate distribution error in both outlays and sales for the sector. Each discrepancy is examined individually and reconciled on a case-by-case basis. Fortunately, the sources of relatively large discrepancies could be isolated and remedied through additional examination. Small discrepancies were reconciled by using imports from and exports to the world other than Wyoming as residual accounts.

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[11]The gross flow patterns were arrived at in either one of two ways. First there was a method that used payroll data (described in the preceeding footnote) when an adequate total gross output value had not been identified. The second method distributed gross flows within the bounds of a total gross output value based on the relative allocation of the flows identified on initially aggregated questionnaire forms.

DATA SOURCES BY SECTOR

Agricultural Production and Livestock   SIC 01, 02, 07, 08

    Wyoming. Wyoming Crop and Livestock Reporting Service. Wyoming
        Agricultural Statistics. 1978.

Coal Production   SIC 12
Mines N.E.C.   SIC 10, 14 (except 144)
Oil and Natural Gas Production   SIC 13

    Barlow and Haun, Inc. Oil and Gas Production, Reserves and Resources
        in Wyoming. (Prepared for Minerals Division, Department of
        Economic Planning and Development, State of Wyoming.) September,
        1978.

    Glass, Gary B. Wyoming Coal and Their Uses. (Information Circular.)
        Laramie, Wyoming: The Geological Survey of Wyoming, University
        of Wyoming. Circa. 1976.

    Industry Survey Data.

    Monteith, Bob. Oil and Gas in Wyoming. (Information Circular.)
        Laramie, Wyoming: The Geological Survey of Wyoming, University
        of Wyoming. Circa. 1976.

    Wyoming. Department of Economic Planning and Development. Coal and
        Uranium Development of the Powder River Basin -- An Impact
        Analysis. June 1974.

    Wyoming. Department of Economic Planning and Development. Minerals
        Division. Mineral Development Monitoring System. Designed and
        implemented by Stuart/Nichols Associates. Current.

    Wyoming. Department of Economic Planning and Development. Minerals
        Division. Oil and Gas Production, Reserves and Resources in
        Wyoming. Prepared by Barlow and Haun, Inc. September 1978.

    Wyoming. Department of Labor and Statistics. Wyoming Coal Strip
        Mining: A Wage and Employment Survey. 1979.

    Wyoming. Department of Labor and Statistics. Wyoming Crude Petroleum
        and Natural Gas Production: A Manpower Survey. April 1977.

    Wyoming. Department of Labor and Statistics. Wyoming Trona and
        Bentonite Industries: A Manpower Survey. April 1977.

    Wyoming. Department of Labor and Statistics. Wyoming - The Uranium
        Industry: A Manpower Survey. October 1977.

    Wyoming. Employment Security Commission. Data from Form 202 quarterly
        reports.

Construction   SIC 144, 15, 16, 17

    Industry Survey Data.

       Wyoming. Department of Labor and Statistics. Building Trades Index:
          State of Wyoming. 1979.

       Wyoming. Department of Labor and Statistics. Wyoming's Construction
          Industry: A Manpower Survey. September 1976.

       Wyoming. Employment Security Commission. Data from Form 202 quarterly
          reports.

All Manufacturing   SIC 20, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34,
                     35, 38, 39

    Industry Survey Data.

       Wyoming. Department of Labor and Statistics. A Manpower Study of the
          Logging and Sawmill Industries in Wyoming. January 1972.

       Wyoming. Employment Security Commission. Data from Form 202 quarterly
          reports.

Transportation and Communication   SIC 40, 41, 42, 44, 45, 46, 47, 48

       Cramer, Curtis A. Pipeline Transportation in Wyoming. (Prepared for
          the Wyoming State Highway Department.) Laramie, Wyoming: Division
          of Business and Economic Research, College of Commerce and Industry,
          University of Wyoming. June 1973.

    Industry Survey Data.

       Wyoming. Employment Security Commission. Data from Form 202 quarterly
          reports.

       Wyoming. Public Service Commission. Files.

Electricity and Natural Gas Utilities   SIC 491, 492

       Ackerman, Jean C., proj. mgr. The Rate Also Rises: An Analysis of
          Electric and Natural Gas Utilities in Wyoming. (Sponsored by
          Community Action of Laramie County, Inc.) January 1977.

       Bickert, Brown, Coddington and Associates, Inc. Wyoming Energy Consump-
          tion: Minerals, Fuels, Electrical Generation and Agricultural
          Sectors. (Prepared for Mineral Development Division, Department
          of Economic Planning and Development, State of Wyoming.) June 1975.

    Industry Survey Data.

       Wyoming. Employment Security Commission. Data from Form 202 quarterly
          reports.

Wyoming.   Public Service Commission.   Files.

Wholesale Trade; also   SIC 50, 51
  Retail Trade   SIC 52, 53, 54, 55, 56, 57, 58, 59

Industry Survey Data.

Wyoming.   Department of Administration and Fiscal Control.   Division of
    Research and Statistics.   Sales and Use Tax Collections, by County,
    by Major Industries, for Fiscal Years 1970 through 1976.   December
    1976.

Wyoming.   Department of Revenue and Taxation.   Annual Report.   1978.

Wyoming.   Employment Security Commission.   Data from Form 202 quarterly
    reports.

Finance, Insurance, and Real Estate   SIC 60, 61, 62, 63, 64, 65, 66

Denver Research Institute.   Analysis of Financing Problems in Coal and
    Oil Shale Boomtowns.   (Prepared for Federal Energy Administration
    NTIS PB-259 438.)   July 1976.

Industry Survey Data.

Sheshunoff and Company, Inc.   Banks of the Great Plains.   (A private
    publication.)   1977.

Wyoming.   Department of Insurance.

Wyoming.   Department of Labor and Statistics.   Wyoming--The Banking
    Industry: A Manpower Survey.   April 1978.

Wyoming.   Employment Security Commission.   Data from Form 202 quarterly
    reports.

Wyoming.   State Examiner.   Division of Banks.   Annual Report.   1977.

Services   SIC 70, 72, 73, 75, 76, 78, 79, 81, 84, 86, 88, 89

Industry Survey Data.

Wyoming.   Department of Labor and Statistics.   Data from Form 202 quarterly
    reports.

Medical   SIC 80

Industry Survey Data.

Wyoming.   Department of Health and Social Services.   Division of Health
    and Medical Services.   Directory of Medical Facilities.   Licensure
    year 1975-76.

Wyoming. Department of Health and Social Services. State Health Planning and Development Agency. Wyoming -- Health Profiles. 1978.

Wyoming. Department of Labor and Statistics. Wyoming's Hospitals: A Manpower Survey. October 1975.

Wyoming. Employment Security Commission. Data from Form 202 quarterly reports.

Education   SIC 82

Industry Survey Data.

Wyoming. Department of Education. Files.

Wyoming. Employment Security Commission. Data from Form 202 quarterly reports.

Water and Sanitation; also
Local and County Roads; also
Local and County Government; also
State Government; also
Federal Government

Community Services Administration. Geographic Distribution of Federal Funds in Wyoming. Fiscal Year 1978.

Industry Survey Data.

Thompson, Layton S. and Willard D. Schutz. Taxation and Revenue Systems in Wyoming. Laramie, Wyoming: Wyoming Agricultural Experiment Station, University of Wyoming. October 1978.

U.S. Department of the Interior. Bureau of Land Management. BLM in Wyoming: A Report to the Public. 1979.

Wyoming. Department of Administration and Fiscal Control. Division of Research and Statistics. Sales and Use Tax Collections, by County, by Major Industries, for Fiscal Years 1970 through 1976. December 1976.

Wyoming. Department of Administration and Fiscal Control. Division of Research and Statistics. Wyoming Tax Revenue Report. 1978.

Wyoming. Department of Economic Planning and Development. Division of Industrial Development. "Community Profile" series for various communities. 1977.

Wyoming. Department of Economic Planning and Development. Wyoming Tax Report. August 1977.

Wyoming. Department of Revenue and Taxation. Annual Report. 1978.

Wyoming. Department of Revenue and Taxation. Ad Valorem Tax Division. <u>Annual Report</u>. 1978.

Wyoming. Employment Security Commission. Data from Form 202 quarterly reports.

Wyoming. State Examiner. <u>Cost of Maintaining County Government in Wyoming</u>. Fiscal 1978.

Wyoming Taxpayers Association. <u>Wyoming Property Tax Rates</u>. 1978.

CHAPTER 3

ANALYSIS OF THE TRI-COUNTY REGION OF SOUTHERN WYOMING

INTRODUCTION

The results of the descriptive analysis of the tri-county economy are presented in this chapter. The discussion contained in the chapter includes: the description of the economy; an analysis of the nature and magnitude of economic interdependence among processing sectors; the various business activity and income multipliers; and an analysis of employment in the region.

The description and analysis of the economy hinges on three major components of the interindustry model. These are: the gross flows or transactions table; the table of direct production requirements; and the table of direct plus indirect production requirements. These tables are discussed and interpreted in turn. Because of the size of the tables, they are presented in the appendix.

THE TRANSACTIONS TABLE

The first essential component of any interindustry study is the collection and tabulation of data which serve to describe the flows of commodities from each supplying sector to each purchasing sector. These flows are typically expressed in terms of the dollar value of transactions occurring in a specific period of time, normally one year. The information is arrayed in tabular form with the suppliers (selling sectors) listed at the left of the table and the purchasing sectors listed at the top. The information in this table, termed the transactions table, does two things simultaneously: it identifies the estimated dollar value of sales by each sector to each of the

other sectors, (thus, the distribution of each sector's output) and it identifies the purchases of ingredients of production by each sector from each of the other sectors (the distribution of purchases). In essence, the material contained in the transactions table represents a double-entry system of bookkeeping in which every sale is simultaneously described as a purchase. Thus, the system deliberately double counts. The transactions table for the Wyoming economy is found in the appendix. A description of the sector identification labels used throughout the appendix and in the tables of this chapter is also shown in the appendix.

The rows and columns of Table B-1 which are numbered 1-17, identify the processing, or intermediate demand, sectors. (The household sector in row and column 20 is included in the processing sector also when the projection scenarios are developed.) Row and column 19 represent subtotals of activities within the processing sector. This portion of the table describes, in dollar terms, the flow of goods and services necessary to satisfy intermediate demands. Final demands, i.e., demands for goods and services that will not be further processed within the region, are identified in columns 20-22 and 24-27. Rows 20-22 and 24-27 identify the final payments sector. Final payments include, then, federal and state taxes, wages, profits, rents, losses, net inventory depletions, and payments for goods and services imported from outside the region. The rows and columns numbered 18 and 23 (the local and county government tax account and the transfer account) are accounting devices as described previously. The last row and column of Table B-1 contain, respectively, total outlay (purchases) and total output (sales) for each sector of the regional economy.

The distribution of total output of each sector, according to the sectors in which the output is sold, may be readily discerned by reading across the

rows of Table B-1. The bill of purchases by each sector is found by reading down any column of the table. These column entries show the allocation of purchases by cost component.

For example, consider sector 2, coal mines. Reading across row 2 of Table B-1 shows that the total output of coal mines was distributed in the following way: $17,101,536 worth of output was sold to electric and natural gas utilities and $12,360,873 to coal mines. Total sales by coal mines to the processing sector of the economy thus amounted to $29,462,409. The remaining sales were to the final demand sectors consisting of households, $35,731, net inventory accumulation, $20,299,867; and exports to the rest of the world, $180,324,567. Total sales to final demand thus amounted to $200,660,165. The total gross output of the coal mines sector is the sum of these individual sales or $230,122,574.

The distribution of purchases by coal mines, by cost category, are shown in column 2 of Table B-1. Purchases by coal mines from agriculture were $427,887; from coal mines $12,360,873; from repair and maintenance construction, $1,332,158; from all manufacturing, $5,022,901; from transportation and communication, $402,043; from electricity and natural gas utilities, $663,131; from wholesale trade, $95,574; from retail trade, $19,498; from finance, insurance and real estate, $2,850,541; from services, $1,700,930; and from water and sanitation, $4,279. Coal mining paid local property and sales taxes amounting to $11,050,654. The total purchases by coal mines from the processing sector are thus estimated at $35,430,469 for 1977. Final payments made by coal mines were estimated at $194,192,105. These payments were distributed as follows: wages subject to withholding, $41,427,309; taxes and charges of the State of Wyoming, $15,583,031; taxes and charges of the Federal Government, $31,930,619; profits, royalties, and rents, $37,440,000;

depreciation, $17,924,275; insurance loss pool (transfer account), $479,853; imports from Wyoming, $17,269,070; imports from the rest of the world, $32,137,948. Total purchases thus amount to $230,122,574 and, as required by the accounting format, equal the value of output.

Other information can be obtained directly from the transactions table. The household row, with the exception of the sale by households to the transfer account represents wages paid subject to withholding. This row shows household income. The leading contributors to household income are: mines n.e.c., with payments to labor of $85.68 million; construction, $74.97 million; education, $63.4 million; transportation/communication, $45.2 million; retail, $44 million; coal mines, $41.4 million; and oil and gas exploration, $31.3 million. Similarly, sector by sector contributions to taxes may be directly obtained from Table B-1. The sectors showing the greatest dollar outlay for local and county taxes are: oil and natural gas, $12.6 million; coal mines, $11 million; electric and gas utilities, $10.4 million; mines n.e.c., $10.3 million; households, $8.7 million; transportation/communication, $5 million; agriculture, $2.7 million.

Estimates of gross regional income and gross regional product may be obtained from the final payments and final demands portion of the table. Gross regional product is defined as the sum of deliveries to final demand, net of imports. Traditionally, local and county government activities are included as part of final demand. Because this model treats these accounts as part of the processing sector, an adjustment is required. Also, the transfer and tax accounts cannot be counted in final demand, for to do so would be double counting. Thus the sum of education; water, sewerage, and sanitation; local roads; local government; households; state government;

federal government; investment and inventory accumulation; oil R and D; and exports from the tri-county region, less regional imports, yields the estimated gross regional product of $1,613 million. Gross regional income (which must equal gross regional product) is computed as the sum of final payments excluding imports. Again, the local and county tax account and the transfer account must also be excluded to avoid double counting.

While these items, obtained directly from the transactions table, are useful as initial indicators of the relative importance of each sector in the regional economy, the important question of interdependence is not addressed. In order to do so, it is first necessary to isolate the direct production relationships existing in the economy.

DIRECT PRODUCTION REQUIREMENTS

The direct production requirements, or coefficients, represent the second major component of the interindustry analysis. These direct requirements are presented in the appendix. Computation of the direct production requirements is quite simple, given the transactions table and requires only that each column entry of the transactions table be divided by the respective column total. The resulting coefficients describe the direct purchases necessary from each supplier (at the left of the table) in order for the purchasing sector (at the head of the column) to produce one dollar's worth of output. The coefficients, then, are interpreted as the direct requirements per dollar of output produced by each sector.

As an example consider the coal mining sector, sector 2 (column 2 of the direct requirements table). For every dollar's worth of output produced by coal mines in the region, $.0019 worth of agricultural products are requiring $.0537 worth of inputs are required from the coal mining and related services sector; $.0058 from construction; $.0218 from regional manufacturing;

$.0017 from transportation and communication; and so on down the column. It is obvious from the table that far and away the largest direct purchases made by the coal mining sector are those for labor services, with a direct outlay of over 18 cents per each dollar of output produced, and imports from outside the region, with a coefficient of .2147 for all imports. This says that a dollar's worth of production in surface coal requires imports valued at 21½ cents. Each column of the direct requirements table is interpreted in this manner.

These direct requirements identify only a portion of the total economic impacts that would accompany a change in final demands for the output of a given sector. There are additional, or indirect, impacts which can be quite important. Assessment of all direct and indirect impacts of these exogenous (final demand) changes is made possible through the third analytical component of interindustry analysis. This component is the table of direct plus indirect production requirements.

DIRECT PLUS INDIRECT IMPACTS

The concept of interdependence can be fairly easily established with a brief example. Suppose that the export demand for coal production increases. There will be immediate, or direct, responses of the following type. Coal production will have to increase. In order for coal production to increase, inputs must be obtained from sectors such as transportation, utilities for power, and labor. These are direct impacts. As transportation and utilities increase their output to meet the increasing requirements in the coal sector, their own requirements for productive ingredients increase, e.g., services, labor, petroleum and natural gas, and coal. The chain of events goes on.

The total impacts are readily estimated through the input-output framework and are presented in the appendix.

Before proceeding to a discussion of the table, a few comments regarding the treatment of households are in order. Households may be treated as either a part of the processing sector of the economy or as a part of the final demand component. In the first instance, households are treated in precisely the same manner as any other production sector. The estimate of the direct and indirect production impacts of a change in final demand include the induced production impacts which derive from increased household incomes and increased consumption. In the latter, with households a component in final demand, the _induced_ impacts of successive rounds of consumer spending are omitted. For purposes of this report, the discussion of economic inter-dependencies and the subsequent business and income multiplier analysis is based upon the model which includes households both as a member of the processing sector of the economy and as a final demand sector.

The direct plus indirect coefficients are interpreted as the production required or generated in all sectors of the economy in order to sustain the delivery of one dollar's worth of output to final demand by any single sector. It should be carefully noted that these coefficients reflect production generated per dollar of final demand as opposed to requirements per dollar of output. This, of course, reflects the fact that the model is driven by changes in final demand.

For purposes of interpretation, consider the coal mining sector. Suppose that the export demand for surface mined coal increases by $1 million. What is the estimated impact that this increase will have on the entire tri-county region of the southern Wyoming economy? The answer to this

question may be obtained directly by reading down column two of the table
and summing the individual sector impacts. Thus, the increase of $1 million
in the final demand for coal generates a total direct plus indirect produc-
tion valued at $3,300 in agriculture ($1 million x .0033); $1,059 million in
coal mining and related services; $500 in mines n.e.c.; $4,800 in oil and
gas production; $11,300 in construction; $33,800 in regional manufacturing;
and so on down the column. Any column of this table is interpreted in this
same manner. The sum of the entries in column 2 show the total production
generated locally as a result of the increase in final demands for surface
mined coal. Thus, the total business activity generated per dollar increase
in final demand for coal is $1.631 or, in our example assuming a $1 million
increase, $1.63 million worth of business activity results. These column
sums are one of the various multipliers concepts which are derived from input-
output analysis.

BUSINESS MULTIPLIERS

The column sums of the direct plus indirect requirements table are termed
business activity (or production) multipliers. They identify the total value
of production in the region which results from a dollar's worth of output
delivered to final demand. Table 3-1 presents the business multipliers.
These estimates indicate that the greatest business activity generated per
dollar of delivery to final demand is in the local tax account. The business
multiplier for this sector is 2.835 which indicates that, as the "final
demand" for local sales and property taxes increases by $1, a total production
of $2.83 is generated in the tri-county economy. Other sectors of the economy
which have relatively large business multipliers are: education, 2.158; local
government, 2.113; transportation/communication, 2.084; electric and gas

utilities, 2.060; retail, 2.048; water and sanitation, 2.035; local roads, 1,962: and agriculture 1.937. These sectors show the greatest degree of interdependence with other sectors of the regional economy. At the margin, these sectors generate the greatest business activity per dollar of output delivered to final demand. The phrase, "at the margin," is important as a qualification in the use of these multipliers. It implies a word of caution concerning the implications of the multipliers. The electricity and natural gas sector in 1977 had total final demand deliveries of $82,665,581. Thus a 10 percent increase in final demand, i.e., an increase of $8,266,558, would result in a total business activity of $17,029,109 in the regional economy. This same 10 percent increase in the final demand for the output of oil and natural gas production, an increase of $14,899,690, yields a total business activity of $22,885,924 in the regional economy. This is, of course, because of the larger absolute magnitude of final demands for the oil and natural gas sector's output. In using the business multipliers, the argument thus should be stated in terms of the impacts of an equal dollar increase in final demands. Thus, for an equal increase (in dollar terms) in final demands, transportation/communication industries will generate more business activity in the local economy than will any other private sector. The first column of Table 3-1 shows the business multipliers with households in final demand; the second column shows the business multipliers with households endogenous (part of the processing sector).

INCOME MULTIPLIERS

Other multiplier effects can also be estimated from the interindustry model. For example, there are income multipliers which relate to changes in income paid to the household sector. The following discussion presents what are termed the Type I and Type II income multipliers.

TABLE 3-1

BUSINESS ACTIVITY MULTIPLIERS
TRI-COUNTY REGION OF SOUTHERN WYOMING
BY SECTOR, 1977

(In dollars of business activity generated in the tri-county region
of southern Wyoming per dollar delivered to final demand)

	Sector	Business Multiplier I	Business Multiplier II
1.	Ag/Livestock	1.648	1.937
2.	Coal Mines	1.233	1.631
3.	Mines N.E.C.	1.161	1.600
4.	Oil/Gas PR	1.323	1.536
5.	Construct	1.289	1.893
6.	All Mfg	1.268	1.608
7.	Trans/Comm	1.217	2.084
8.	Elec/Gs Ut	1.700	2.060
9.	Wholesale	1.263	1.810
10.	Retail	1.264	2.048
11.	Fin/Ins/RE	1.054	1.222
12.	Services	1.263	1.908
13.	Medical	1.143	1.635
14.	Education	1.144	2.158
15.	Wat/San	1.529	2.035
16.	Loc Roads	1.275	1.962
17.	Loc Gov	1.229	2.113
18.	Loc Taxes	2.050	2.835
19.	Households		1.766

TABLE 3-2

INCOME MULTIPLIERS
TRI-COUNTY REGION OF SOUTHERN WYOMING
BY SECTOR, 1977

(In dollars of income generated per dollar of
direct income paid to households)

	Sector	Income Multipliers	
		Type I	Type II
1.	Ag/Livestock	2.700	3.119
2.	Coal Mines	1.253	1.447
3.	Mines N.E.C.	1.141	1.318
4.	Oil/Gas Pr	1.941	2.241
5.	Construct	1.256	1.450
6.	All Mfg	1.307	1.510
7.	Trans/Comm	1.097	1.267
8.	Elec/Gs Ut	2.094	2.418
9.	Wholesale	1.334	1.541
10.	Retail	1.165	1.346
11.	Fin/Ins/RE	1.163	1.344
12.	Services	1.183	1.366
13.	Medical	1.124	1.298
14.	Education	1.060	1.224
15.	Wat/San	1.259	1.454
16.	Loc Roads	1.229	1.419
17.	Loc Gov	1.118	1.292

The Type I and Type II income multipliers are estimated ratios: Type I is the ratio of direct plus indirect income to the direct income paid households; Type II is the ratio of direct plus indirect plus induced income to direct income. Thus, while the business activity multipliers are related to changes in sales to final demand, the income multipliers are related to changes in income paid to the household sector. The Type I multiplier describes the direct plus indirect income increases emanating from an additional dollar of direct income paid to households. The Type II multiplier takes into account not only the direct plus indirect changes in income, but also the induced income increases generated by additional consumer spending. Accordingly, the Type II income multiplier identifies the direct plus indirect plus induced income generated by an additional dollar of income paid directly to households.

Attention is drawn to the comparatively higher income multiplier value estimates for the agriculture and livestock sector. The reason for this relatively high value is straightforward. The tri-county interindustry study allocated proprietorship and partnership net incomes to the profit account. As a result, labor inputs (household account) for agriculture and livestock, are somewhat understated because this sector is characterized by a relatively high incidence of proprietorship and partnership enterprises with relatively little hired help. By understating the value (contribution) of labor inputs for this sector, the value (contribution) of other inputs, relative to labor, became larger. And with direct income being the denominator of the Type I and Type II income multiplier ratios, the multiplier estimate for this sector is of the relatively high magnitude observed. By contrast, the relatively high multiplier values for electricity and natural gas utilities, oil and gas production, and wholesale trade exist because these sectors exhibit greater interdependence in the tri-county economy.

EMPLOYMENT ANALYSIS

Direct employment requirements as is the case with direct business activity and direct income payments, are, by themselves, of limited use for assessing the impacts of various changes in economic activity in the tri-county region. This limitation arises because direct requirements differ from total requirements, the difference being indirect requirements that emanate from sectoral interdependence. The interindustry model provides a framework within which both direct and indirect employment requirements can be addressed. Basic to the analysis are data on employment levels in the respective sectors and the table of direct plus indirect requirements per dollar of output delivered to final demand.

Before proceeding with the analysis some discussion on the table of direct and indirect requirements per dollar of delivery to final demand is warranted. When the household sector is included as a processing sector in the interindustry model it becomes simply another producer. To treat households in this manner is consistent within the interindustry framework, but it imposes a critical assumption on household purchase patterns. Specifically, household purchases are expressed as a linear function of income; the marginal and the average propensities to consume are assumed to be one and the same. To change this limiting assumption, the household sector has to be treated as a part of final demand.

Treating the household sector in this manner removes the assumption that household purchases are a linear function of income. Specifically, because the interindustry model is a final demand driven model, treating the household sector as any other producing sector implies the level of employment was dependent only on the level of state and federal government expenditures,

investment expenditures, inventory accumulation, and exports. By treating households exogenously this assumption is expanded to include a dependency on the level of household expenditures. Direct and indirect requirements per dollar of delivery to final demand, households exogenous, which are used in the employment analysis for the tri-county region of southern Wyoming are shown in the appendix. The estimated employment levels and corresponding employment coefficients (expressed as the number of employees per dollar of total gross output) used in the analysis are presented in Table 3-3.

To assess the total employment impacts of exogenous changes in final demand, the respective tables of direct and indirect requirements per dollar of delivery to final demand, households exogenous, were pre-multiplied by a diagonal matrix of direct labor use requirements (where the elements of the diagonal are the employment coefficients shown in Table 3-3). Summing down the respective columns of the resulting matrix yielded the estimates of the direct and indirect labor requirements per dollar delivered to final demand. Table 3-4 presents the estimates.

The interpretation of the entries in Table 3-4 is demonstrated by an example from the coal mining sector. As the final demand for the output of coal expands by $1, there will be a direct expansion of employment in that sector as well as those sectors responsible for supplying production ingredients to the coal mining sector. The sectors supplying ingredients to the surface mining of coal sector will in turn require production ingredients from others and this will further expand indirect employment impacts; and so forth. The magnitude of the direct and indirect employment impacts, .01192, shows the total employment generated in the entire southern Wyoming economy as this single sector, coal mining, increases by $1,000, its deliveries to final demand. That is to say that an increase of $1 million in the final

TABLE 3-3

TOTAL EMPLOYMENT AND EMPLOYMENT COEFFICIENTS
TRI-COUNTY REGION OF SOUTHERN WYOMING
BY SECTOR, 1977

(In number of workers in the tri-county region of southern
Wyoming and workers per thousand dollars of output)

	Sector	Total Employment	Workers Per Thousand $ Total Output
1.	Ag/Livestock	1,135*	.01195
2.	Coal Mines	1,902	.00826
3.	Mines N.E.C.	4,464	.01136
4.	Oil/Gas Pr	114	.00061
5.	Construct	4,604	.01673
6.	All Mfg	1,218	.01058
7.	Trans/Comm	1,628	.01614
8.	Elec/Gs Ut	572	.00484
9.	Wholesale	890	.01737
10.	Retail	6,820	.05914
11.	Fin/Ins/RE	1,041	.00852
12.	Services	3,335	.04219
13.	Medical	1,353	.02648
14.	Education	4,750	.04062
15.	Wat/San	159	.02629
16.	Loc Roads	162	.03552
17.	Loc Gov	949	.05884
18.	Loc Taxes	-	-
19.	Households	348	.00054
20.	State Gov	-	-
21.	Fed Gov	-	-

*Crude estimates from data presented in the 1974 Census of Agriculture put
this employment figure at 560, but Census value of farm sales appears to be
understated raising the employment coefficient from federal data to 0.01664.
Employment for 1975 from Wyoming Data Handbook is 954.

TABLE 3-4

DIRECT PLUS INDIRECT LABOR REQUIREMENTS PER THOUSAND DOLLARS
DELIVERED TO FINAL DEMAND AND PER ADDED WORKER HIRED
TRI-COUNTY REGION OF SOUTHERN WYOMING
BY SECTOR, 1977

Sector	Direct + Indirect Labor Requirement Per Thousand $ of Final Demand		Direct + Indirect Labor Requirement Per Added Worker Hired
1. Ag/Livestock	.02441	(.02726)*	2.043
2. Coal Mines	.01192	(.01584)	1.443
3. Mines N.E.C.	.01362	(.01795)	1.199
4. Oil/Gas Pr	.00523	(.00733)	8.574
5. Construct	.02196	(.02791)	1.313
6. All Mfg	.01348	(.01683)	1.274
7. Trans/Comm	.01983	(.02838)	1.229
8. Elec. Gs Ut	.01241	(.01596)	2.564
9. Wholesale	.02230	(.02769)	1.284
10. Retail	.06341	(.07114)	1.072
11. Fin/Ins/RE	.00984	(.01150)	1.155
12. Services	.04719	(.05355)	1.119
13. Medical	.02948	(.03433)	1.113
14. Education	.04303	(.05303)	1.059
15. Wat/San	.03237	(.03736)	1.231
16. Loc Roads	.04155	(.04832)	1.170
17. Loc Gov	.06344	(.07215)	1.078
18. Loc Taxes	-		-

*The column of employment multipliers enclosed in parentheses includes direct, indirect, and induced labor requirements.

demands, e.g., exports to the rest of Wyoming or out of state, for coal would result in an estimated additional employment of twelve persons in the tri-county region. All remaining entries in Table 3-4 have analogous interpretations for their respective sectors. Thus, the leading sectors in terms of direct and indirect employment generation in the tri-county economy are local government, retail, services, education, local roads, water and sanitation and medical. Table 3-4 also shows the total employment impact of exogenous changes in workers hired. This information is found simply by dividing the direct plus indirect labor requirements per thousand dollars of final demand (in Table 3-4) by the workers per thousand dollars of final demand shown in Table 3-3. The workers added per worker hired column shows that for each worker hired by coal mines, 0.443 workers are hired throughout the region's economy. Thus the multiplier for exogenous changes in coal mine employment is 1.443.

CHAPTER 4

EXTENSIONS OF THE BASIS ANALYSIS:
REGIONAL WATER REQUIREMENTS

INTRODUCTION

The previous chapter presented what may be appropriately called the results of traditional applications of the Leontief interindustry model. In addition to the descriptive analysis and the attendant development of various multipliers, application of the model can be extended to other questions. The I-O technique, because of the detailed analysis of interdependence among economic sectors, is readily adaptable to an examination of resource use associated with economic activity in the region. This chapter is concerned with an analysis of water withdrawal and consumptive use in the southern Wyoming regional economy. Other resource impacts, e.g., water and air quality impacts, land use, and growth of various types of energy consumption, could also be studied, providing adequate data are available.

WATER USE ANALYSIS

The water use analysis requires data pertaining to water withdrawals and consumptive use on a sector-by-sector basis. It is further required that these data be related to economic activity on a per dollar sales basis. . These data, particularly for consumptive use, are difficult to obtain on a sector-by-sector basis and for a rather small regional economy.

Water use by commercial establishments is very small relative to agriculture, the extractive industries, electricity generation, and manufacturing. Little detailed information is available from secondary

sources for the commercial sectors and, thus most coefficients are based upon results from our Wyoming survey and past surveys and Water Resources Council[1] estimates. The Water Resources Council Report provides no detail among commercial establishments. WRC data was also at variance with other data in the agricultural and manufacturing sectors. The primary data source for the agricultural sector was the Census of Agriculture.[2] The withdrawal rate per dollar of output estimated from Census data was almost twice the size of the rate estimated from Water Resources Council data. Because of the indirect procedure required to convert the secondary data to a useful form for the input-output analysis, the exact source of the discrepancy is not easily traced. Water use estimates for the extractive sectors are based mainly upon the Census of Mineral Industries.[3] Unfortunately, disclosure problems limit the available data to rather large regions in some cases. Withdrawal and consumptive use figures vary considerably among regions and their accuracy for a relatively small region

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[1]The Nation's Water Resources, 1975-2000, Vol. 3: Analytical Data Appendix II, Annual Water Supply and Use Analysis, Table II-4, Annual Water Requirements for Offstream Uses, Base Conditions, No/So Platte Region, Subregion 1007, Dec. 1978; and as above, Analytical Data Appendix I, Social, Economic, and Environmental Data, and Table I-2, Earnings by Major Sectors, No/So Platte Region, Subregion 1007, December 1978, Second National Water Assessment by the U.S. Water Resources Council.

[2]1974 Census of Agriculture, Vol. I, part 50, Wyoming, State and County Data, U.S. Dept. of Commerce, Bureau of the Census, Table 3, page IV-8; Table 13, page IV-12; Table 3, page IV-26, Table 13, page IV-30, Table 3, page IV-116, Table 13, page IV-120.

[3]1972 Census of Mineral Industries, Subject Series, Water Use in Mineral Industries, MIC72(1)-2, Sept. 1975, Table 2B, Gross Water Used and Water Intake, By Source and Kind, for Geographic Areas and Major Industry Groups; and as above, Table 2C, Gross Water Used and Water Intake, By Source and Kind, for Water Use Regions and Major Industry Groups; and as above, Table 1C, Selected Water Use Statistics for Water Use Regions: 1972; Sept. 1975.

is questionable. Water use in manufacturing is taken from the Census of Manufacturers.[4] In a few cases, disclosure prevents the use of regional water data. However, the magnitude of the error involved in the computation of the weighted average coefficients for the region is probably quite small.

Estimates of withdrawal and consumptive use by sector are shown in Table 4-1. Where more than one data source is available, multiple estimates are shown. In most cases, the larger numbers are derived from the source which is considered to be more authoritative for the region. In each sector we have used the largest figure shown in Table 4-1 for the water analysis which follows.

Table 4-2 presents the estimated withdrawals and consumptive use for each of the processing sectors of the regional economy in millions of gallons. Oil and Gas Production, Ag/Livestock and Mines N.E.C. account for over 91 percent of withdrawals and over 98 percent of consumptive use in the region.

It should be noted that the estimates presented in Tables 4-1 and 4-2 do not include water use in the final demand/final payments sector. In order to assess total water use, it is necessary to have some indication of requirements in the final demand sectors, e.g., households and governments. Aggregated data generally show depletions for irrigation as a separate category of water use and a second category consisting of municipal and industrial and domestic water use. Since industrial, commercial, mining, and agricultural water use has been estimated above, the final demand use   .

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[4] 1972 Census of Manufacturers, Water Use in Manufacturing, Special Report Series, Sept. 1975, Table 2C, Gross Water Used and Water Intake, by Source and Kind, For Water Use Regions and Major Industry Groups: 1973; and as above, Table 5C, Gross Water Used Including Recirculated, Total Water Intake, and Treated and Untreated Water Discharged, By Point of Discharge, For Water Use Regions and Major Industry Groups: 1973.

of water could be computed as a residual if estimates of total withdrawal and total consumption were available.

Estimates of total withdrawal and total consumptive use of water are useful from a purely descriptive point of view. However, the model allows also the analysis of direct and indirect water use which parallels the previous discussion of direct and indirect production. The purpose of such analysis is to isolate the effect of economic interdependence on water requirements. The specific question to be addressed is that of determining the likely impact of expanding final demand in any or all processing sectors on the regional water requirements. The key element in the assessment is the derivation of the direct plus indirect water requirements per dollar of output delivered to final demand.

The calculation of water multipliers is not difficult once the direct water requirements and the table of direct plus indirect production requirements have been obtained. The matrix of direct and indirect production coefficients is premultiplied by a diagonal matrix consisting of the direct water requirements along the diagonal and zeros elsewhere. The columns of the resulting matrix are summed in order to obtain the direct plus indirect water requirements per dollar of output delivered to final demand by each sector. These requirements for the tri-county economy are shown in Table 4-3. The importance of considering indirect as well as direct water requirements in the planning perspective can be readily seen by comparing Table 4-1 and Table 4-3. Consider, for example the direct withdrawal and consumptive use requirements for coal mines in Table 4-1. The direct requirements are 15.5 and 1.02 gallons for each dollar of output. However, as the final demand for the output of the coal sector expands by one dollar, there is a total direct plus indirect water requirement of 31.4 gallons (withdrawal) and 6.2 gallons (consumptive) generated throughout the economy. The indirect

impacts, because of the significant interdependencies within and between coal and other sectors, are far more important than the direct requirements. Applying only the direct water requirements to assumed increases in deliveries to final demand can obviously result in an understatement of water use.

TABLE 4-1

ESTIMATED WITHDRAWAL AND CONSUMPTIVE USE
REQUIREMENTS BY SECTOR, TRI-COUNTY REGION
OF SOUTHERN WYOMING
(In Gallons Per Dollar of Output)

	Sector	Withdrawal		Consumptive Use		
1.	Ag/Livestock	792.7^1	$1,550^5$	314.2^1	609^6	
2.	Coal Mines	15.5^3		0^3	1.02^4	
3.	Mines N.E.C.	306.1^3	53.5^1	21.3^1	30.6^4	
4.	Oil/Gas Pr	$1,031.0^3$		0^3	529.2^4	
5.	Construct	4.0^6		0.4^6		
6.	All Mfg	27.6^2	6.4^1	8.9^2	1.5^1	3.7^4
7.	Trans/Comm	2.1^6		0.1^6		
8.	Elec/Gs Ut	267.0^6		13.4^6	13.6^4	
9.	Wholesale	2.3^6		0.6^4		
10.	Retail	3.9^6		0.6^6	1.0^4	
11.	Fin/Ins/RE	4.9^6		0.2^6	1.2^4	
12.	Services	3.5^6		0.7^6	0.9^4	
13.	Medical	5.1^6		0.5^6	1.3^4	
14.	Education	1.5^6		0.2^6	0.4^4	
15.	Wat/San	0		0		
16.	Loc Roads	0		0		
17.	Loc Gov	0		0		

[1] Water Resources Council, based on ratio of withdrawal to wages and profits.

[2] Census of Water Use in Manufacturing, ratio of withdrawal or consumptive use to value of shipments.

[3] Census of Mineral Industries, ratio of withdrawal to value of shipments.

[4] Water Resources Council, ratio of consumption to withdrawal.

[5] Census of Agriculture, ratio of consumptive use to value of shipments.

[6] Survey data or estimated on per capita basis.

TABLE 4-2

TOTAL WATER USE, BY PROCESSING SECTORS,
TRI-COUNTY REGION OF SOUTHERN WYOMING
(In Millions of Gallons)

	Sector	Withdrawal	Consumptive Use
1.	Ag/Livestock	147,203	57,837
2.	Coal Mines	3,567	235
3.	Mines N.E.C.	120,249	12,021
4.	Oil/Gas Pr	192,489	98,802
5.	Construct	1,101	110
6.	All Mfg	3,178	1,025
7.	Trans/Comm	212	10
8.	Elec/Gs Ut	31,577	1,608
9.	Wholesale	118	31
10.	Retail	45	12
11.	Fin/Ins/RE	599	147
12.	Services	277	71
13.	Medical	261	66
14.	Education	175	47
15.	Wat/San	0	0
16.	Loc Roads	0	0
17.	Loc Gov	0	0
		501,051	172,022

TABLE 4-3

DIRECT PLUS INDIRECT WATER REQUIREMENTS,
TRI-COUNTY REGION OF SOUTHERN WYOMING, 1977
(In Gallons Per Dollar of Output Delivered to Final Demand)

	Sector	Withdrawal	Consumptive Use
1.	Ag/Livestock	1,782.3	698.5
2.	Coal Mines	31.4	6.2
3.	Mines N.E.C.	333.1	37.0
4.	Oil/Gas Pr	1,114.1	566.8
5.	Construct	25.5	6.6
6.	All Mfg	140.6	62.1
7.	Trans/Comm	28.5	8.4
8.	Elec/Gs Ut	446.9	99.4
9.	Wholesale	16.9	4.7
10.	Retail	31.2	8.7
11.	Fin/Ins/RE	9.7	2.6
12.	Services	27.2	7.2
13.	Medical	16.3	4.7
14.	Education	29.4	7.9
15.	Wat/San	--	--
16.	Loc Roads	--	--
17.	Loc Gov	--	--

APPENDICES

Appendix:

APPENDIX A

SECTOR IDENTIFICATION, TRI-COUNTY REGION
OF SOUTHERN WYOMING, 1977

Sector Number	Sector Description	1972 SIC Codes
Processing Sectors		
1.	Ag/Livestock	02,07,08
2.	Coal Mines	12
3.	Mines, NEC	10,14(less 144
4.	Oil/Gas Production	13
5.	Construction	144,15,16,17
6.	All Manufacturing	20,23,24,25,26 27,28,29,31,32 33,34,35,38,39
7.	Transportation/Communication	40,41,42,44,45 46,47,48
8.	Electricity ; Gas Utilities	491,492
9.	Whoesale Trade	50,51
10.	Retail Trade	52,53,54,55,56 57,58,59
11.	Finance, Insurance, Real Estate	60,61,62,63,64 65,66
12.	Services, NEC	70,72,73,75,76 78,79,81,83,84 86,88,89
13.	Medical Services	80
14.	Education	82
15.	Water, Sewerage, Trash Removal Services	495,497
16.	Local and County Roads	-
17.	Local and County Government	91,92,93,94,95 96

APPENDIX A (Continued)

Sector Number	Sector Description	1972 SIC Codes
	Local and County Tax Accounts	-
	Subtotals	
	Final Demand Sectors	
	Households	-
	State of Wyoming	91,92,93,94,95, 96,97
	Federal Government	91,92,93,94,95, 96,97
	Transfer Account	-
	Economic Investment	-
	Oil R and D	-
	Exports to Wyoming Other Than the Tri-County Region	-
	Exports to the Rest of the World	-
	Totals	

APPENDIX B

INPUT-OUTPUT TABLES FOR THE TRI-COUNTY REGION
OF SOUTHERN WYOMING, 1977

APPENDIX B-1

TRI-COUNTY REGION OF SOUTHERN WYOMING (1977)

GROSS FLOWS TABLE (last rows show resource inputs)

		1 AG/LIVESTK	2 COAL-MINES	3 MINES-MEC	4 OIL/GAS-PR	5 CONSTRUCT	6 ALL-MFG	7 TRANS/COMM	8 ELEC/GS-UT	9 WHOLESALE	10 RETAIL
1	AG/LIVESTK	11549528.	427887.	0.	0.	9027.	0.	0.	0.	0.	0.
2	COAL-MINES	0.	12360873.	0.	0.	0.	910323.	0.	0.	0.	0.
3	MINES-MEC	0.	0.	4018314.	0.	3132166.	9875974.	0.	17101536.	0.	0.
4	OIL/GAS-PR	0.	0.	0.	10832209.	0.	957435.	0.	105000.	0.	0.
5	CONSTRUCT	9146.	1332158.	1822534.	781045.	33701341.	2214079.	0.	16821861.	0.	549603.
6	ALL-MFG	1991074.	5022901.	3701855.	1910366.	9892009.	2629716.	4695651.	807890.	494825.	2133353.
7	TRANS/COMM	66194.	402043.	2710176.	2363986.	1717312.	1655407.	811073.	650209.	79011.	7498485.
8	ELEC/GS-UT	1114188.	663131.	13393515.	5392951.	488689.	335983.	1314347.	81043.	5176658.	2779990.
9	WHOLESALE	211285.	95574.	2546185.	1129274.	840734.	292784.	0.	2663606.	382014.	75820.
10	RETAIL	6909882.	19498.	331006.	325570.	2538950.	1346888.	84542.	67331.	37600.	378002.
11	FIN/INS/RE	18687707.	2850541.	0.	834861.	4249213.	718700.	189030.	15075.	270479.	5491652.
12	SERVICES	2208089.	1700930.	146520.	1546938.	4134642.	7140.	613668.	10625142.	1873134.	2288476.
13	MEDICAL	1458.	0.	399091.	977.	120830.	9208.	598515.	58957.	1249505.	0.
14	EDUCATION	0.	0.	0.	0.	226502.	10998.	0.	0.	2700.	0.
15	WATER/SAN	88100.	4279.	0.	30443.	181113.	0.	504613.	10597.	2443.	178226.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	0.	18367.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	LOC-TAXES	2741322.	11050654.	10265963.	12555450.	1100017.	1742661.	4972270.	10350166.	896455.	1806360.
19	SUBTOTALS	46172953.	35930469.	39335159.	37704070.	62333254.	22707296.	13783709.	59558413.	10463389.	23179965.
20	HOUSEHOLDS	5761675.	41427309.	85680019.	11629293.	74969419.	16970774.	45158354.	11509661.	11898014.	43955566.
21	STATE-GOV	339848.	15583031.	5623399.	7548587.	1177753.	619532.	1901102.	288681.	550578.	797815.
22	FED-GOV	1405732.	31930619.	24524910.	19153525.	12078325.	4145843.	6682512.	2134297.	5289667.	9777057.
23	TRANSFERS	3145844.	479853.	0.	1140532.	715302.	226732.	31820.	1822279.	315319.	924452.
24	PROFITS	3277162.	37440000.	70855077.	75776864.	12822912.	9705872.	8836026.	21796616.	14538595.	25729160.
25	DEPREC	14412119.	17924275.	42108302.	5053460.	13042545.	2746967.	7616396.	17753898.	1781933.	4150468.
26	IMP-WYOM	2654620.	17269070.	53703475.	19184344.	49560348.	33636121.	6892849.	681417.	930490.	2792858.
27	IMP-WORLD	17799698.	32137946.	71013060.	10510289.	48449669.	24402387.	9949573.	2718892.	5452093.	4002622.
28	TOTALS	94969851.	230122574.	392843404.	186700966.	275148820.	115161524.	100852341.	118264152.	51240078.	115309963.

		1	2	3	4	5	6	7	8	9	10
1	EMPLOYMENT	0.1135E 04	0.1901E 04	0.4463E 04	0.1139E 03	0.4603E 04	0.1218E 04	0.1628E 04	0.5724E 03	0.8900E 03	0.6819E 04
2	WITHDRAWAL	0.1472E 12	0.3567E 10	0.1202E 12	0.1925E 12	0.1101E 10	0.3178E 10	0.2118E 09	0.3158E 11	0.1179E 09	0.4497E 09
3	CONSUMP.	0.5784E 11	0.2347E 09	0.1202E 11	0.9880E 11	0.1101E 11	0.1025E 10	0.1009E 09	0.1608E 10	0.3074E 08	0.1153E 09

APPENDIX B-1 (continued)

GROSS FLOWS TABLE (last rows show resource inputs)

		11 FIN/INS/RE	12 SERVICES	13 MEDICAL	14 EDUCATION	15 WATER/SAN	16 LOC-ROADS	17 LOC-GOV	18 LOC-TAXES	19 SUBTOTALS	20 HOUSEHOLDS
1	AG/LIVESTK	0.	0.	3126.	0.	0.	0.	0.	0.	11989568.	2240727.
2	COAL-MINES	0.	0.	0.	0.	0.	0.	0.	0.	29462409.	35731.
3	MINES-NEC	0.	0.	0.	0.	0.	0.	0.	0.	8165803.	353672.
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.	0.	0.	37530044.	0.
5	CONSTRUCT	117474.	940931.	5059.	2681911.	7689.	536400.	858698.	0.	45604139.	2383450.
6	ALL-MFG	635820.	556644.	460322.	91362.	3863.	8800.	108154.	0.	34146673.	12959883.
7	TRANS/COMM	689864.	1927017.	390273.	2129867.	21458.	25000.	158503.	341399.	29719065.	16532935.
8	ELEC/GS-UT	269368.	1917564.	135615.	2906746.	184793.	180346.	311667.	0.	35598571.	14039671.
9	WHOLESALE	3763.	1061510.	87282.	34448.	0.	0.	63252.	0.	7080367.	15926478.
10	RETAIL	223529.	897457.	196198.	81023.	106692.	146224.	241738.	0.	13058849.	75923109.
11	FIN/INS/RE	603302.	4317175.	1476629.	1954819.	2513618.	26533.	417831.	0.	57658075.	57258462.
12	SERVICES	2063671.	2551937.	622208.	2175326.	49440.	8000.	186900.	0.	22323907.	29250577.
13	MEDICAL	0.	0.	1921771.	19081.	0.	0.	561104.	7317723.	10950390.	28327639.
14	EDUCATION	0.	7518.	0.	45033.	0.	0.	0.	29836279.	30126983.	3834672.
15	WATER/SAN	24732.	421214.	34197.	186987.	0.	40000.	20320.	363214.	2117398.	3665709.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	4560795.	4560795.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	16127774.	16127774.	0.
18	LOC-TAXES	356749.	1139796.	525369.	0.	0.	0.	0.	0.	59503252.	8654053.
19	SUBTOTALS	4988272.	15738763.	5858049.	12616603.	2887553.	971303.	2928167.	58547184.	455729876.	271386972.
20	HOUSEHOLDS	10001604.	24422558.	12645512.	63407338.	1377501.	1443993.	7213971.	0.	469472568.	2040879.
21	STATE-GOV	252613.	262265.	3505.	1594231.	9120.	2000.	165884.	0.	36708824.	35175787.
22	FED-GOV	3177768.	3884481.	1044934.	1031281.	423136.	4467.	60031.	0.	126332102.	111462155.
23	TRANSFERS	69579354.	726743.	248572.	5645157.	47781.	51000.	747514.	0.	85177076.	9638757.
24	PROFITS	9206564.	11147691.	24677974.	15861977.	85542.	0.	3245704.	7296856.	352318836.	22649515.
25	DEPREC	703526.	5187300.	962497.	0.	0.	0.	0.	0.	133529226.	0.
26	IMP-WYOM	17361208.	5302445.	2445703.	8347802.	197392.	566012.	292658.	0.	221818818.	36652600.
27	IMP-WORLD	6925168.	12368520.	3214188.	8432082.	1019401.	1522020.	1473845.	0.	261391458.	156312700.
28	TOTALS	122196077.	79040766.	51100934.	116936471.	6047426.	4560795.	16127774.	65844040.	2142467792.	645319368.

		11	12	13	14	15	16	17	18	19	20
1	EMPLOYMENT	0.1041×10^{4}	0.3335×10^{4}	0.1353×10^{4}	0.4750×10^{4}	0.1590×10^{3}	0.1620×10^{3}	0.9490×10^{3}	0.	0.	0.
2	WITHDRAWAL	0.5988×10^{9}	0.2766×10^{9}	0.2606×10^{9}	0.1754×10^{9}	0.	0.	0.	0.	0.	0.
3	CONSUMP.	0.1466×10^{9}	0.7114×10^{8}	0.6643×10^{8}	0.4677×10^{8}	0.	0.	0.	0.	0.	0.

1 EMPLOYMENT 0.1041E 04 0.3335E 04 0.1333E 04 0.4730E 04 0. 0. 0.
2 WITHDRAWAL 0.5988E 09 0.2766E 09 0.2606E 09 0.175AE 09 0. 0. 0.
3 CONSUMP. 0.1466E 08 0.7114E 08 0.6843E 08 0.4677E 08 0. 0. 0.

APPENDIX B-1 (continued)

GROSS FLOWS TABLE (last rows show resource inputs)

	21 STATE-GOV	22 FED-GOV	23 TRANSFERS	24 INVESTMENT	25 OIL-R+D	26 EXP-WYOM	27 EXP-WORLD	28 TOTALS
1 AG/LIVESTK	245.	0.	0.	0.	300000.	10279638.	70159273.	94969651.
2 COAL-MINES	0.	0.	0.	20299867.	0.	0.	180324566.	230122574.
3 MINES-NEC	0.	0.	0.	0.	1311.	0.	384322616.	392843404.
4 OIL/GAS-PR	0.	0.	0.	0.	0.	0.	149170922.	186700966.
5 CONSTRUCT	25545732.	21158811.	925907.	121481669.	580048910.	0.	0.	275148820.
6 ALL-MFG	666814.	8313.	0.	0.	454614.	3345261.	63578966.	115161524.
7 TRANS/COMM	189612.	800266.	0.	0.	2671112.	0.	50939351.	100652341.
8 ELEC/GS-UT	34513.	146494.	0.	0.	529459.	37734387.	30181057.	118264152.
9 WHOLESALE	65357.	131780.	0.	23598761.	1071447.	3345888.	0.	51240078.
10 RETAIL	254972.	104740.	252729.	16764094.	1142735.	4780397.	3028538.	115309963.
11 FIN/INS/RE	71322.	15899.	0.	0.	7192319.	0.	0.	122196077.
12 SERVICES	681483.	535572.	5116011.	5420034.	2185227.	0.	13527955.	79040766.
13 MEDICAL	334247.	156000.	10324244.	0.	8414.	0.	1000000.	51100934.
14 EDUCATION	51440014.	13795058.	0.	0.	0.	10926209.	6813535.	116936471.
15 WATER/SAN	2049.	0.	0.	0.	262270.	0.	0.	6047426.
16 LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	4560795.
17 LOC-GOV	0.	0.	0.	0.	0.	0.	0.	16127774.
18 LOC-TAXES	0.	0.	-3200000.	0.	667021.	0.	219714.	65844040.
19 SUBTOTALS	79286360.	36852933.	13418891.	187564426.	74534839.	70432980.	953266488.	2142467760.
20 HOUSEHOLDS	3970465.	10369076.	128143400.	0.	31322981.	0.	645319376.	
21 STATE-GOV	240398.	28897184.	0.	0.	413300.	1621028.	919318.	1037775839.
22 FED-GOV	266914.	907160.	0.	0.	6654910.	0.	2223865.	247847108.
23 TRANSFERS	18222982.	167239452.	0.	0.	1210738.	0.	0.	281489008.
24 PROFITS	358019.	1793155.	-86951454.	0.	100998930.	0.	52003979.	352265988.
25 DEPREC	167350.	28688.	0.	0.	6062026.	0.	0.	139787290.
26 IMP-WYOM	336900.	793260.	16349496.	33659421.	5486634.	2666420.	517053.	318280604.
27 IMP-WORLD	926451.	1166198.	2305508532.	103928162.	22116869.	6934960.	7530146.	790815480.
28 TOTALS	1037775839.	247847108.	301468868.	325152012.	157901228.	81655388.	1016460848.	5022048384.

1 EMPLOYMENT	0.	0.	0.	0.	0.	0.	0.	0.
2 WITHDRAWAL	0.	0.	0.	0.	0.	0.	0.	0.
3 CONSUMP.	0.	0.	0.	0.	0.	0.	0.	0.

APPENDIX B-2

TRI-COUNTY REGION OF SOUTHERN WYOMING (1977)

Direct Requirements Per Dollar of Output

	1 AG/LIVESTK	2 COAL-MINES	3 MINES-NEC	4 OIL/GAS-PR	5 CONSTRUCT	6 ALL-MFG	7 TRANS/COMM	8 ELEC/GS-UT	9 WHOLESALE	10 RETAIL
1 AG/LIVESTK	0.121613	0.001859	0.	0.	0.000033	0.	0.	0.	0.	0.
2 COAL-MINES	0.	0.053714	0.	0.	0.	0.	0.	0.144605	0.	0.
3 MINES-NEC	0.	0.	0.010229	0.	0.011384	0.007905	0.	0.000888	0.	0.
4 OIL/GAS-PR	0.	0.	0.	0.058019	0.	0.085758	0.	0.142240	0.	0.
5 CONSTRUCT	0.000096	0.005789	0.004639	0.004183	0.122484	0.008314	0.046560	0.006831	0.009657	0.004766
6 ALL-MFG	0.020965	0.021827	0.009423	0.010232	0.035951	0.019226	0.008042	0.005498	0.001542	0.018501
7 TRANS/COMM	0.006962	0.001747	0.006899	0.012662	0.006241	0.022635	0.013032	0.000665	0.101031	0.065029
8 ELEC/GS-UT	0.011732	0.002882	0.034094	0.028686	0.001776	0.014375	0.000838	0.022523	0.007455	0.024109
9 WHOLESALE	0.002225	0.000415	0.006481	0.006049	0.003056	0.002917	0.001874	0.005569	0.000734	0.000658
10 RETAIL	0.072759	0.000085	0.000843	0.001744	0.009228	0.002542	0.006085	0.000127	0.005279	0.003278
11 FIN/INS/RE	0.196776	0.012387	0.	0.004472	0.015443	0.011696	0.005935	0.091534	0.036556	0.047625
12 SERVICES	0.023250	0.007391	0.000373	0.008286	0.015027	0.006241	0.005003	0.000499	0.024385	0.019846
13 MEDICAL	0.000015	0.	0.001016	0.000005	0.000439	0.000062	0.	0.000053	0.	0.
14 EDUCATION	0.	0.000019	0.	0.	0.000823	0.000080	0.	0.000048	0.	0.001546
15 WATER/SAN	0.000928	0.	0.000019	0.000163	0.000658	0.000096	0.	0.000090	0.000558	0.
16 LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17 LOC-GOV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18 LOC-TAXES	0.028865	0.048021	0.026133	0.067249	0.003998	0.015132	0.049302	0.087517	0.017495	0.015665
19 HOUSEHOLDS	0.060669	0.180023	0.218102	0.062288	0.272469	0.147365	0.447767	0.097322	0.232201	0.381195
20 STATE-GOV	0.003578	0.067716	0.014315	0.040431	0.004280	0.005380	0.018850	0.002441	0.010745	0.006919
21 FED-GOV	0.014802	0.138755	0.062429	0.102589	0.043897	0.036000	0.066260	0.018047	0.103233	0.084789
22 TRANSFERS	0.033125	0.002085	0.	0.000753	0.002600	0.001969	0.000316	0.015409	0.006154	0.008017
23 PROFITS	0.034507	0.162696	0.180365	0.405673	0.046604	0.084281	0.087613	0.184305	0.283735	0.223130
24 DEPREC	0.151755	0.077890	0.107189	0.027067	0.047402	0.023853	0.075520	0.150121	0.034776	0.035994
25 IMP-WYOM	0.027952	0.075043	0.136705	0.102754	0.180122	0.292078	0.068346	0.005762	0.018159	0.624220
26 IMP-WORLD	0.187425	0.139656	0.180767	0.056295	0.176085	0.211897	0.098655	0.022990	0.106403	0.034712

Direct Requirements Per Dollar of Output

		11 FIN/INS/RE	12 SERVICES	13 MEDICAL	14 EDUCATION	15 WATER/SAN	16 LOC-ROADS	17 LOC-GOV	18 LOC-TAXES	19 HOUSEHOLDS	20 STATE-GOV
1	AG/LIVESTK	0.	0.	0.000061	0.	0.	0.	0.	0.	0.003472	0.000002
2	COAL-MINES	0.	0.	0.	0.	0.	0.	0.	0.	0.000055	0.
3	MINES-NEC	0.	0.	0.	0.	0.	0.	0.	0.	0.000548	0.
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	CONSTRUCT	0.000961	0.011904	0.000099	0.022955	0.001271	0.117611	0.053243	0.	0.003694	0.246163
6	ALL-MFG	0.005203	0.007042	0.009008	0.000781	0.000639	0.	0.006706	0.	0.020083	0.006426
7	TRANS/COMM	0.005646	0.024380	0.007637	0.018214	0.003548	0.001929	0.009828	0.005185	0.025620	0.001827
8	ELEC/GS-UT	0.002204	0.024260	0.002654	0.024857	0.030557	0.005482	0.019325	0.	0.021756	0.000333
9	WHOLESALE	0.000031	0.013430	0.001708	0.002946	0.	0.039543	0.003922	0.	0.024680	0.000630
10	RETAIL	0.001829	0.011354	0.003839	0.000693	0.017643	0.032061	0.014989	0.	0.117652	0.002457
11	FIN/INS/RE	0.004937	0.054620	0.028896	0.016717	0.415651	0.005818	0.025908	0.	0.068729	0.000687
12	SERVICES	0.016888	0.032286	0.012176	0.018603	0.008175	0.001754	0.011589	0.	0.045327	0.006567
13	MEDICAL	0.	0.	0.037807	0.000163	0.	0.	0.034791	0.111137	0.043897	0.003221
14	EDUCATION	0.	0.000095	0.	0.000385	0.	0.	0.	0.453136	0.005942	0.495684
15	WATER/SAN	0.000202	0.005329	0.000669	0.001599	0.	0.008770	0.001260	0.005516	0.005680	0.000020
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	0.069287	0.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	0.244939	0.	0.
18	LOC-TAXES	0.002919	0.014420	0.010281	0.	0.	0.	0.	0.	0.013410	0.
19	HOUSEHOLDS	0.081849	0.308987	0.247461	0.542237	0.227783	0.316610	0.447301	0.	0.003163	0.038260
20	STATE-GOV	0.002067	0.003318	0.000069	0.013633	0.001508	0.000439	0.010286	0.	0.054509	0.002317
21	FED-GOV	0.026005	0.049145	0.020448	0.088819	0.069970	0.000979	0.003722	0.	0.172724	0.002572
22	TRANSFERS	0.569407	0.009195	0.004364	0.048275	0.007901	0.011182	0.046349	0.110820	0.014936	0.175599
23	PROFITS	0.075343	0.141037	0.482926	0.135646	0.014145	0.	0.201249	0.	0.035098	0.003450
24	DEPREC	0.005757	0.065628	0.018835	0.	0.032641	0.124104	0.	0.	0.	0.001613
25	IMP-WYOM	0.142077	0.067085	0.047860	0.071387	0.168568	0.333718	0.018146	0.	0.056798	0.003246
26	IMP-WORLD	0.056673	0.156483	0.062899	0.072108	0.	0.	0.091386	0.	0.242225	0.008927

APPENDIX B-2 (continued)

Direct Requirements Per Dollar of Output

		21 FED-GOV	22 TRANSFERS	23 INVESTMENT	24 OIL-R+D	25 EXP-WYOM	26 EXP-WORLD
1	AG/LIVESTK	0.	0.	0.	0.001900	0.125893	0.069023
2	COAL-MINES	0.	0.	0.062432	0.	0.	0.177404
3	MINES-NEC	0.	0.	0.	0.000008	0.	0.378099
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.146755
5	CONSTRUCT	0.085370	0.003071	0.373615	0.367628	0.	0.
6	ALL-MFG	0.000034	0.	0.	0.002879	0.040980	0.062549
7	TRANS/COMM	0.003229	0.	0.	0.016916	0.	0.050114
8	ELEC/GS-UT	0.000591	0.	0.	0.003553	0.462118	0.029692
9	WHOLESALE	0.000532	0.	0.072578	0.006786	0.041221	0.
10	RETAIL	0.000423	0.008638	0.051558	0.007237	0.056544	0.002979
11	FIN/INS/RE	0.000064	0.	0.	0.045549	0.	0.
12	SERVICES	0.002161	0.016970	0.016669	0.013839	0.	0.013309
13	MEDICAL	0.000629	0.034246	0.	0.000053	0.	0.000984
14	EDUCATION	0.055660	0.	0.	0.	0.133809	0.006703
15	WATER/SAN	0.	0.	0.	0.001661	0.	0.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.
18	LOC-TAXES	0.	-0.010615	0.	0.004224	0.	0.000216
19	HOUSEHOLDS	0.041837	0.425063	0.	0.198371	0.	0.
20	STATE-GOV	0.115786	0.	0.	0.002617	0.019852	0.000904
21	FED-GOV	0.003660	0.	0.	0.042146	0.	0.002188
22	TRANSFERS	0.674769	0.	0.	0.007668	0.	0.
23	PROFITS	0.007235	-0.288426	0.	0.063957	0.	0.051162
24	DEPREC	0.000116	0.	0.	0.038391	0.	0.
25	IMP-WYOM	0.003201	0.054233	0.103519	0.034747	0.032655	0.000509
26	IMP-WORLD	0.004705	0.764618	0.319629	0.140068	0.084930	0.007408

APPENDIX B-3

TRI-COUNTY REGION OF SOUTHERN WYOMING (1977)

APPENDIX D-3

TRI-COUNTY REGION OF SOUTHERN WYOMING (1977)

Direct and Indirect Requirements Per Dollar Delivered to Final Demand
(Households in Processing Sector)

	1 AG/LIVESTK	2 COAL-MINES	3 MINES-NEC	4 OIL/GAS-PR	5 CONSTRUCT	6 ALL-MFG	7 TRANS/COMM	8 ELEC/GS-UT	9 WHOLESALE	10 RETAIL
1 AG/LIVESTK	1.1392	0.0033	0.0012	0.0006	0.0016	0.0009	0.0023	0.0013	0.0014	0.0020
2 COAL-MINES	0.0037	1.0587	0.0069	0.0058	0.0025	0.0040	0.0050	0.1586	0.0032	0.0065
3 MINES-NEC	0.0004	0.0005	1.0108	0.0004	0.0138	0.0085	0.0009	0.0014	0.0005	0.0007
4 OIL/GAS-PR	0.0067	0.0048	0.0085	1.0688	0.0073	0.0976	0.0107	0.1584	0.0048	0.0098
5 CONSTRUCT	0.0046	0.0113	0.0092	0.0096	1.1438	0.0132	0.0070	0.0159	0.0152	0.0110
6 ALL-MFG	0.0338	0.0315	0.0187	0.0167	0.0536	1.0288	0.0639	0.0190	0.0173	0.0370
7 TRANS/COMM	0.0250	0.0143	0.0203	0.0221	0.0260	0.0352	1.0334	0.0157	0.1183	0.0684
8 ELEC/GS-UT	0.0242	0.0125	0.0448	0.0378	0.0160	0.0258	0.0323	1.0377	0.0210	0.0423
9 WHOLESALE	0.0083	0.0077	0.0143	0.0107	0.0143	0.0097	0.0153	0.0085	1.0106	0.0145
10 RETAIL	0.1071	0.0321	0.0357	0.0195	0.0594	0.0299	0.0696	0.0299	0.0490	1.0656
11 FIN/INS/RE	0.2552	0.0442	0.0357	0.0260	0.0634	0.0399	0.0689	0.1262	0.0795	0.1089
12 SERVICES	0.0444	0.0235	0.0169	0.0185	0.0401	0.0205	0.0382	0.0194	0.0465	0.0502
13 MEDICAL	0.0142	0.0192	0.0190	0.0164	0.0208	0.0143	0.0405	0.0251	0.0212	0.0283
14 EDUCATION	0.0208	0.0280	0.0189	0.0370	0.0108	0.0154	0.0333	0.0535	0.0171	0.0189
15 WATER/SAN	0.0030	0.0022	0.0022	0.0018	0.0036	0.0020	0.0092	0.0026	0.0036	0.0056
16 LOC-ROADS	0.0030	0.0040	0.0026	0.0055	0.0011	0.0021	0.0046	0.0080	0.0023	0.0024
17 LOC-GOV	0.0106	0.0143	0.0093	0.0195	0.0040	0.0075	0.0162	0.0282	0.0081	0.0085
18 LOC-TAXES	0.0433	0.0584	0.0378	0.0798	0.0155	0.0308	0.0659	0.1150	0.0329	0.0349
19 HOUSEHOLDS	0.1892	0.2604	0.2874	0.1396	0.3952	0.2225	0.5672	0.2353	0.3578	0.5129

APPENDIX B-3 (continued)

Direct and Indirect Requirements Per Dollar Delivered to Final Demand (Households in Processing Sector)

		11 FIN/INS/RE	12 SERVICES	13 MEDICAL	14 EDUCATION	15 WATER/SAN	16 LOC-ROADS	17 LOC-GOV	18 LOC-TAXES	19 HOUSEHOLDS
1	AG/LIVESTK	0.0004	0.0017	0.0013	0.0026	0.0013	0.0018	0.0023	0.0021	0.0046
2	COAL-MINES	0.0010	0.0061	0.0020	0.0071	0.0066	0.0032	0.0059	0.0052	0.0052
3	MINES-NEC	0.0002	0.0007	0.0004	0.0009	0.0004	0.0020	0.0013	0.0009	0.0010
4	OIL/GAS-PR	0.0018	0.0080	0.0037	0.0089	0.0077	0.0048	0.0082	0.0069	0.0079
5	CONSTRUCT	0.0024	0.0186	0.0034	0.0319	0.0053	0.1384	0.0659	0.0406	0.0087
6	ALL-MFG	0.0089	0.0217	0.0191	0.0211	0.0131	0.0184	0.0264	0.0198	0.0310
7	TRANS/COMM	0.0110	0.0457	0.0224	0.0464	0.0212	0.0276	0.0361	0.0397	0.0461
8	ELEC/GS-UT	0.0063	0.0398	0.0133	0.0460	0.0432	0.0209	0.0383	0.0336	0.0336
9	WHOLESALE	0.0032	0.0251	0.0104	0.0206	0.0089	0.0518	0.0194	0.0190	0.0299
10	RETAIL	0.0153	0.0631	0.0429	0.0809	0.0585	0.0878	0.0854	0.0691	0.1385
11	FIN/INS/RE	1.0185	0.1092	0.0669	0.0933	0.4586	0.0644	0.0948	0.0803	0.1241
12	SERVICES	0.0237	1.0586	0.0313	0.0560	0.0343	0.0303	0.0457	0.0426	0.0619
13	MEDICAL	0.0059	0.0233	1.0563	0.0332	0.0169	0.0225	0.0650	0.1502	0.0563
14	EDUCATION	0.0036	0.0162	0.0108	1.0133	0.0081	0.0090	0.0115	0.4640	0.0190
15	WATER/SAN	0.0011	0.0087	0.0030	0.0063	1.0025	0.0120	0.0054	0.0109	0.0076
16	LOC-ROADS	0.0005	0.0021	0.0014	0.0014	0.0009	1.0010	0.0012	0.0704	0.0018
17	LOC-GOV	0.0016	0.0073	0.0048	0.0048	0.0033	0.0034	1.0043	0.2491	0.0065
18	LOC-TAXES	0.0066	0.0300	0.0196	0.0197	0.0135	0.0138	0.0178	1.0168	0.0267
19	HOUSEHOLDS	0.1100	0.4222	0.3213	0.6636	0.3311	0.4494	0.5777	0.5138	1.1550

APPENDIX B-4

TRI-COUNTY REGION OF SOUTHERN WYOMING (1977)

APPENDIX B-4

TRI-COUNTY REGION OF SOUTHERN WYOMING (1977)

Direct and Indirect Requirements Per Dollar Delivered to Final Demand
(Households in Final Demand)

	1 AG/LIVESTK	2 COAL-MINES	3 MINES-NEC	4 OIL/GAS-PR	5 CONSTRUCT	6 ALL-MFG	7 TRANS/COMM	8 ELEC/GS-UT	9 WHOLESALE	10 RETAIL
1 AG/LIVESTK	1.1385	0.0022	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000
2 COAL-MINES	0.0029	1.0575	0.0056	0.0052	0.0007	0.0030	0.0024	0.1575	0.0016	0.0042
3 MINES-NEC	0.0003	0.0003	1.0105	0.0002	0.0135	0.0083	0.0004	0.0012	0.0002	0.0003
4 OIL/GAS-PR	0.0054	0.0030	0.0065	1.0679	0.0046	0.0960	0.0068	0.1568	0.0023	0.0363
5 CONSTRUCT	0.0032	0.0093	0.0070	0.0065	1.1408	0.0115	0.0027	0.0141	0.0125	0.0072
6 ALL-MFG	0.0287	0.0245	0.0110	0.0130	0.0430	1.0228	0.0487	0.0127	0.0077	0.0233
7 TRANS/COMM	0.0175	0.0039	0.0088	0.0166	0.0102	0.0263	1.0107	0.0063	0.1040	0.0679
8 ELEC/GS-UT	0.0187	0.0049	0.0364	0.0338	0.0045	0.0194	0.0158	1.0308	0.0106	0.0274
9 WHOLESALE	0.0034	0.0010	0.0069	0.0071	0.0040	0.0039	0.0006	0.0024	1.0013	0.0012
10 RETAIL	0.0844	0.0009	0.0013	0.0027	0.0110	0.0032	0.0016	0.0016	0.0061	1.0040
11 FIN/INS/RE	0.2348	0.0163	0.0048	0.0110	0.0210	0.0159	0.0080	0.1009	0.0410	0.0538
12 SERVICES	0.0342	0.0095	0.0015	0.0110	0.0189	0.0086	0.0078	0.0068	0.0274	0.0227
13 MEDICAL	0.0050	0.0065	0.0050	0.0096	0.0015	0.0034	0.0128	0.0137	0.0112	0.0033
14 EDUCATION	0.0177	0.0237	0.0141	0.0347	0.0043	0.0117	0.0240	0.0497	0.0112	0.0104
15 WATER/SAN	0.0018	0.0005	0.0003	0.0009	0.0010	0.0005	0.0055	0.0010	0.0012	0.0022
16 LOC-ROADS	0.0027	0.0036	0.0022	0.0053	0.0005	0.0018	0.0037	0.0076	0.0017	0.0016
17 LOC-GOV	0.0095	0.0128	0.0076	0.0187	0.0018	0.0063	0.0129	0.0268	0.0060	0.0056
18 LOC-TAXES	0.0389	0.0524	0.0312	0.0765	0.0074	0.0257	0.0528	0.1095	0.0246	0.0230

APPENDIX B-4 (continued)

Direct and Indirect Requirements Per Dollar Delivered to Final Demand
(Households in Final Demand)

		11 FIN/INS/RE	12 SERVICES	13 MEDICAL	14 EDUCATION	15 WATER/SAN	16 LOC-ROADS	17 LOC-GOV	18 LOC-TAXES
1	AG/LIVESTK	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
2	COAL-MINES	0.0005	0.0042	0.0006	0.0041	0.0051	0.0012	0.0033	0.0028
3	MINES-NEC	0.0001	0.0003	0.0001	0.0004	0.0001	0.0016	0.0008	0.0005
4	OIL/GAS-PR	0.0010	0.0051	0.0015	0.0043	0.0055	0.0018	0.0042	0.0034
5	CONSTRUCT	0.0016	0.0155	0.0010	0.0269	0.0028	0.1350	0.0615	0.0368
6	ALL-MFG	0.0059	0.0103	0.0105	0.0033	0.0042	0.0064	0.0109	0.0061
7	TRANS/COMM	0.0066	0.0289	0.0095	0.0198	0.0080	0.0096	0.0130	0.0192
8	ELEC/GS-UT	0.0031	0.0275	0.0039	0.0267	0.0336	0.0079	0.0215	0.0186
9	WHOLESALE	0.0003	0.0142	0.0021	0.0034	0.0004	0.0402	0.0045	0.0057
10	RETAIL	0.0021	0.0124	0.0044	0.0013	0.0188	0.0339	0.0161	0.0075
11	FIN/INS/RE	1.0067	0.0638	0.0324	0.0220	0.4230	0.0161	0.0327	0.0251
12	SERVICES	0.0178	1.0360	0.0141	0.0205	0.0165	0.0062	0.0147	0.0150
13	MEDICAL	0.0005	0.0027	1.0407	0.0009	0.0008	0.0005	0.0368	0.1252
14	EDUCATION	0.0018	0.0093	0.0055	1.0024	0.0026	0.0017	0.0021	0.4556
15	WATER/SAN	0.0004	0.0059	0.0009	0.0019	1.0003	0.0090	0.0015	0.0075
16	LOC-ROADS	0.0003	0.0014	0.0008	0.0003	0.0004	1.0002	0.0003	0.0696
17	LOC-GOV	0.0010	0.0049	0.0030	0.0011	0.0014	0.0008	1.0011	0.2462
18	LOC-TAXES	0.0040	0.0202	0.0122	0.0044	0.0058	0.0034	0.0044	1.0050

Colorado School of Mines

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SURVEY FORM USED FOR THE SOUTHERN WYOMING INTERINDUSTRY STUDY

cal economics department

VOLUNTARY QUESIONNAIRE

Albany, Sweetwater, and Carbon Counties Inter-Industry Analysis

This quesionnaire is designed to enable you to provide us, in as simple a form as possible, a detailed account of your firm's purchases and sales in 1978. The specific focus of the analysis is the component of that activity occurring in Albany, Sweetwater, and Carbon counties.

This information will be handled in strictest confidence. Your responses will be aggregated with those of other firms in your economy sector, eliminating the possibility that any single firm's respones will be identifiable. Participation on your part is voluntary.

1. We are particularly interested in obtaining data which are a reasonable representation of your firm's current operation. Data for a fiscal or calendar year 1978 or later are preferred. In the event that data are not available in this form, please use any consecutive twelve months since 1977 (please indicate).

2. You may indicate sales and purchases in dollar amounts or percentages.

3. When exact data are not available, please use estimates. If it is not possible to provide information for certain questions, please indicate.

Name of Firm: _____

What is your major product(s) or service(s)? If convenient, list the appropriate SIC classification(s). _____

_____

_____

What was the total number of employees you had at any one time in 1978?

Full Time: _____   Part Time: _____

the university of mineral resources

APPENDIX C (continued)
SALES ANALYSIS

DEMAND SOURCE: SECTORS TO WHICH YOU SELL	SALES IN SWEETWATER, CARBON, AND ALBANY COS. ($ or % of Total)	SALES TO OTHER WYO. COUNTIES ($ or % or Total)	SALES OUTSIDE WYOMING ($ or % of Total)
1. AGRICULTURE, LIVESTOCK AND FORESTRY			
2. COAL MINES AND RELATED SERVICES			
3. OIL AND NATURAL GAS PRODUCERS			
4. ALL OTHER MINING AND RELATED SERVICE OPERATORS			
5. ALL CONSTRUCTION (including sand and gravel)			
6. ALL MANUFACTURING (includes processed foods, lumber, chemicals, oil refining, stone, glass, metals, machines, transportation equipment, office equipment, furniture)			
7. ALL TRANSPORTATION AND COMMUNICATION (includes ratio, t.v., advertising, cable subscriptions, telephone)			
8. ELECTRICITY AND GAS UTILITIES			
9. WHOLESALE TRADE (wholesaling intermediaries)			
10. RETAIL TRADE (all retail trade)			
11. FINANCE, INSURANCE AND REAL ESTATE (interest earned, insurance premiums, real estate commissions and management fees, fees and charges by brokers).			
12. ALL OTHER SERVICES (lodging, legal, personal, leasing, amusement, data processing, business, repair, etc.)			
13. HEALTH SERVICES (medical, dental, hospitals, laboratories, patient care facilities)			
14. EDUCATIONAL SERVICES (primary, secondary, college, technical, professional, libraries)			
15. WATER, SEWAGE, TRASH REMOVAL			
16. LOCAL AND COUNTY GOVERNMENT (taxes, permits, licenses)			
17. HOUSEHOLDS (direct sales for private consumption)			
18. WYOMING STATE GOVERNMENT			
19. FEDERAL GOVERNMENT			
20. TOTAL SALES			

At what level of capacity did your establishment operate during 1978? LEVEL OF CAPACITY UTILIZATION
What is your establishment's total water use for all phases of your operations? (Note: Please use any unit of measurements; e.g., gallons per day, 1000 gallons per day, one feet per year, etc.)

TOTAL WATER INTAKE: _____

Please estimate the dollar value of your depletion allowance for 1978.

DEPLETION ALLOWANCE: _____

SALES OUTSI[DE] WYOMING ($ or % of To[tal])	SOURCE: SECTORS FROM WHICH YOU PURCHASE OR PAY EXPENSES	PURCHASES IN SWEET-WATER, CARBON AND ALBANY COUNTIES ($ or % or Total)	PURCHASES FROM OTHER WYOMING COUNTIES ($ or % or Total)	PURCHASES OUT-SIDE WYOMING ($ or % of Total)
	[AGRI]CULTURE, LIVESTOCK AND FORESTRY			
	[COAL] MINES AND RELATED SERVICES			
	[OIL] AND NATURAL GAS PRODUCERS			
	[O]THER MINING AND RELATED SERVICE OPERATORS			
	[C]ONSTRUCTION			
	[M]ANUFACTURING (includes processed foods, [pape]r, chemicals, oil refining, stone, glass, [metal]s, machines, transportation equipment, [offic]e equipment, furniture)			
	[T]RANSPORTATION AND COMMUNICATION [inc]ludes radio, t.v., advertising, cable [subsc]riptions, telephone)			
	[ELEC]TRICITY AND GAS UTILITIES			
	[WHOLE]SALE TRADE (wholesaling intermediaries)			
	[RETAI]L TRADE (all retail trade)			
	[FINAN]CE, INSURANCE, AND REAL ESTATE [(interest payments, insurance premiums, [re]al estate commissions, and management [charg]es, fees and charges by [b]rokers)			
	[O]THER SERVICES (lodging, legal, personal, [clean]ing, amusement, data processing, business, [repai]r, etc.)			
	[HEAL]TH SERVICES (medical, dental, hospitals, [labo]ratories, patient care facilities)			
	[EDUC]ATIONAL SERVICES (primary, secondary, [coll]ege, technical, professional, libraries)			
	[WATER], SEWAGE, TRASH REMOVAL			
	[LOCAL] AND COUNTY GOVERNMENT (taxes, permits, [licen]ses)			
	[HOUS]EHOLDS (payments subject to withholdings)			
	[WYOM]ING STATE GOVERNMENT (taxes, permits, [licen]ses)			
	[FEDE]RAL GOVERNMENT (taxes, permits, license fees, [empl]oyers FICA, unemployment insurance)			
	[PROFIT]S, DIVIDENDS, RETAINED EARNINGS			
	[DEPRE]CIATION ALLOWANCE			
	[TOTA]L PURCHASES			

[I]ndicate the value of your establishment's net inventory change in 1978 (this may be a positive or negative).
[INVE]NTORY CHANGE: $ _____.

BIBLIOGRAPHY

Ackerman, Jean C., proj. mgr. The Rate Also Rises: An Analysis of Electric and National Gas Utilities in Wyoming. (Sponsored by Community Action of Laramie County, Inc.) January 1977.

Barlow and Haun, Inc. Oil and Gas Production, Reserves and Resources in Wyoming. (Prepared for Minerals Division, Department of Economic Planning and Development, State of Wyoming.) September 1978.

Bickert, Brown, Coddington and Associates, Inc. Wyoming Energy Consumption: Minerals, Fuels, Electrical Generation and Agricultural Sectors. (Prepared for Mineral Development Division, Department of Economic Planning and Development, State of Wyoming.) June 1975.

1972 Census of Manufacturers, Water Use In Manufacturing, Special Report Series, Sept. 1975.

1972 Census of Mineral Industries, Subject Series, Water Use in Mineral Mineral Industries, MIC72(1)-2, Sept. 1975.

Community Services Administration. Geographic Distribution of Federal Funds in Wyoming. Fiscal year 1978.

Cramer, Curtis A. Pipeline Transportation in Wyoming. (Prepared for the Wyoming State Highway Department.) Laramie, Wyoming: Division of Business and Economic Research, College of Commerce and Industry, University of Wyoming. June 1973.

Denver Research Institute. Analysis of Financing Problems in Coal and Oil Shale Boomtowns. (Prepared for Federal Energy Administration-NTIS PB 259 and 438.) July 1976.

Glass, Gary B. Wyoming Coal and Their Uses. (Information Circular.) Laramie, Wyoming: The Geological Survey of Wyoming, University of Wyoming. Circa 1976.

Monteith, Bob. Oil and Gas in Wyoming. (Information Circular.) Laramie, Wyoming: The Geological Survey of Wyoming, University of Wyoming. Circa 1976.

Sheshunoff and Company, Inc. Banks of The Great Plains. (A private publication.) 1977.

Thompson, Layton S. and Schutz, Willard D. Taxation and Revenue Systems in Wyoming. Laramie, Wyoming: Wyoming Agricultural Experiment Station, University of Wyoming. October 1978.

U.S. Department of Commerce, Bureau of the Census, 1974 Census of Agriculture, Vol. I, Part 50, Wyoming, State and County Data.

U.S. Department of the Interior. Bureau of Land Management. BLM in Wyoming: A Report to the Public. 1979.

U.S. Water Resources Council, The Nation's Water Resources, 1975-2000, Vol. 3: Analytical Data Appendix II, Annual Water Supply and Use Analysis, Subregion 1007, Dec. 1978.

Wyoming. Department of Administration and Fiscal Control. Wyoming State Government Offices: Telephone Directory.

Wyoming. Department of Administration and Fiscal Control. Division of Research and Statistics. Sales and Use Tax Collections, by County, by Major Industries, for Fiscal Years 1970 through 1976. December 1976.

Wyoming. Department of Administration and Fiscal Control. Division of Research and Statistics. Wyoming Tax Revenue Report. 1978.

Wyoming. Department of Economic Planning and Development. Coal and Uranium Development of the Powder River Basin -- An Impact Analysis. June 1974.

Wyoming. Department of Economic Planning and Development. Directory of Wyoming Planning Officials. June 1977.

Wyoming. Department of Economic Planning and Development. Wyoming Directory of Manufacturing and Mining. 1978.

Wyoming. Department of Economic Planning and Development. Wyoming Tax Report. August 1977.

Wyoming. Department of Economic Planning and Development. Division of Industrial Development. "Community Profile" series for various communities. 1977.

Wyoming. Department of Economic Planning and Development. Minerals Division. Mineral Development Monitoring System. Designed and implemented by Stuart/Nichols Associates. Current.

Wyoming. Department of Economic Planning and Development. Minerals Division. Oil and Gas Production, Reserves and Resources in Wyoming. Prepared by Barlow and Haun, Inc. September 1978.

Wyoming. Department of Education. Files.

Wyoming. Department of Health and Social Services. Division of Health and Medical Services. Directory of Medical Facilities. Licensure year 1975-76.

Wyoming. Department of Health and Social Services. State Health Planning and Development Agency. Wyoming - Health Profiles. 1978.

Wyoming. Department of Insurance.

Wyoming. Department of Labor and Statistics. A Manpower Study of the Logging and Sawmill Industries in Wyoming. January 1972.

Wyoming. Department of Labor and Statistics. Building Trades Index: State of Wyoming. 1979.

Wyoming. Department of Labor and Statistics. Directory of Labor Organizations in Wyoming. Fall 1978.

Wyoming. Department of Labor and Statistics. Wyoming Coal Strip Mining: A Wage and Employment Survey. 1979.

Wyoming. Department of Labor and Statistics. Wyoming Construction Contractors' Directory. 1979.

Wyoming. Department of Labor and Statistics. Wyoming Crude Petroleum and Natural Gas Production: A Manpower Survey. April 1977.

Wyoming. Department of Labor and Statistics. Wyoming -- The Banking Industry: A Manpower Survey. April 1978.

Wyoming. Department of Labor and Statistics. Wyoming - The Uranium Industry: A Manpower Survey. October 1977.

Wyoming. Department of Labor and Statistics. Wyoming Trona and Bentonite Industries: A Manpower Survey. April 1977.

Wyoming. Department of Labor and wtatistics. Wyoming's Construction Industry: A Manpower Survey. September 1976.

Wyoming. Department of Labor and Statistics. Wyoming's Hospitals: A Manpower Survey. October 1975.

Wyoming. Department of Revenue and Taxation. Annual Report. 1978.

Wyoming. Department of Revenue and Taxation. Ad Valorem Tax Division. Annual Report. 1978.

Wyoming. Employment Security Commission. Data from Form 202 quarterly reports.

Wyoming. Employment Security Commission. Research and Analysis Section. State of Wyoming Labor Market Information. Third Quarter 1978.

Wyoming. Public Service Commission. Files.

Wyoming. State Examiner. Cost of Maintaining County Government in Wyoming. Fiscal 1978.

Wyoming. State Examiner. Division of Banks. Annual Report. 1977.

Wyoming. Wyoming Crop and Livestock Reporting Service. Wyoming Agricultural Statistics. 1978.

Wyoming Community Development Authority. Annual Report. 1978.

Wyoming Industrial Development Corporation. Annual Report. 1977.

Wyoming Taxpayers Association. Wyoming Property Tax Rates. 1978.

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