FUTURE ECONOMIC TRENDS
Input/Output Analysis
1: FINAL REPORT

Water Quality Management Plan ①

LARIMER-WELD REGIONAL COUNCIL OF GOVERNMENTS
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FINAL REPORT

FUTURE ECONOMIC TRENDS
INPUT/OUTPUT ANALYSIS

Interindustry Analysis and Economic Profile

of the Larimer-Weld Region

Submitted to

Larimer-Weld Council of Governments

Submitted by

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CHAPTER 1

INTRODUCTION

The purpose of this study is to provide a detailed description of the
regional economy of Larimer and Weld Counties and develop a means for
projecting future economic conditions. Specifically, this report contains:
(1) an economic profile of the regional economy, (2) specification of the
nature and magnitude of interdependence among the various sectors of the
regional economy, (3) estimates of future economic activity to the year 2000
based upon changes in the four most volatile sectors of the economy, and
(4) an extrapolation of projected economic conditions to employment numbers
directly usable by the Colorado Division of Planning for forecasting
population. The input-output model developed in this study is useful for
assessing the performance of the present economy, projecting future economic
and population growth, and evaluating the economic impacts of various public
and private policy decisions.

This chapter deals with four major topics: (1) the nature of the
regional economy, (2) the nature of the study, (3) the nature of the input-
output model utilized in the study, and (4) a descriptive outline of the
report.

Nature of the Regional Economy

Larimer and Weld Counties contain a land area of 6,600 square miles
with an estimated 1974 population of 226,700 persons. The population

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[1] Colorado Department of Revenue, Annual Report for Fiscal Year 1973-74.
Denver, Colorado.

of the area grew from 125,687 persons in 1960 to 179,000 persons in 1970,[2]
an increase of 42.2 percent. The estimated 1974 population represents an
additional 26.6 percent increase over the 1970 figure.

The value of total economic activity in the region was approximately
$7.9 billion in 1974. Nearly $3.4 billion of this amount was contributed
by production activities. Food production and processing accounted for
$1.4 billion or 41 percent of total production; manufacturing contributed
approximately $0.3 billion or 9 percent; retail and wholesale trade added
nearly $1.0 billion or 29 percent; and services totaled $0.2 billion or
6 percent.

Also in 1974, households earned $1.24 billion of income. Local, state
and federal government agencies expended $0.34 billion and a total of $0.18
billion was spent on education. Imports into the region totaled nearly
$2.2 billion and exports amounted to about $1.7 billion.

Nature of the Study

Well-developed economies tend to be characterized by a significant
degree of interaction among various producing sectors. In such economies,
a major portion of economic activity is devoted to the production of
intermediate goods (i.e., goods which are purchased from one producer by
another and are further processed prior to sale for final consumption).
The level of output, or production, of these intermediate goods is closely
tied to the level of output sold for final consumption (or, alternatively,
sold to final demand). An increase in the final demand for any sector's
output (e.g., exports from the food processing sector) implies an increase
in the outputs of intermediate goods (e.g., livestock, irrigated and dryland

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[2] U.S. Bureau of the Census, U.S. Census of Population 1960 and 1970,
Washington, D.C.

agricultural commodities) used by the food processing sector. These impacts are direct production impacts. In addition, the expanded output of livestock and other agricultural products, resulting from an increased final demand for processed foods, leads in turn to an increase in the output of goods used in producing these intermediate products. These latter changes begin what are termed the indirect impacts of the initial change and may, in certain cases, be quite important. From a regional planning perspective, estimates of the magnitude of these direct and indirect impacts of various changes in the economy can provide valuable assistance to the planning process. The primary focus of this study is to specify the interdependencies of the regional economy of Larimer-Weld Counties and provide a mechanism for estimating the direct and indirect impacts of economic changes.

Nature of the Model

An input-output model is utilized to estimate the interdependent economic structure of the Larimer-Weld Counties region. This model provides an account of transactions for each sector of the economy, a calculation of the input requirements of these sectors and a measurement of the effects of growth in demand for the outputs of each sector. Essentially, the model is a system of double entry bookkeeping such that sales and purchases by each sector to and from all other sectors are accounted for and measured.

The model consists of two major components--those transactions which are identified as intermediate transactions and those which are termed final. Intermediate transactions consist of the purchase and sale of inter- mediate goods, (i.e., those which are subject to further local processing). Final transactions include all purchases and sales from or to sectors which are external to the model (i.e., to sectors not identified as intermediate or producing sectors.) Such transactions would include, for example, sales from intermediate

sectors to investment, governments, and exports and purchases by intermediate sectors from governments, construction, or in the form of imports.

The model is driven by the final demand of sectors. Thus, if it is assumed that export activity in any particular sector is going to change, the model estimates the impacts of this change on the entire economy. These impacts, whether measured in terms of employment, income, or the value of production provide consistent estimates of the output, employment, and income which mutually and simultaneously satisfy all requirements for intermediate and final production. Once the essentials of the model have been identified and the basic description of economic transactions developed, forecasting with the analytical technique requires only the specification of appropriate changes in final demand.

Outline of Report

The remainder of the report is an elaboration of these introductory statements. Chapter 2 contains a description of the sectors identified for analysis in the regional economy and the related Standard Industrial Classifications. It concludes with a discussion of data sources for measuring the performances of these sectors.

In Chapter 3, the interdependent economic structure of the regional economy is estimated. This chapter contains an empirical description of the transactions among economic sectors of the regional economy, as estimated for 1974, as well as the analysis of interdependence and the multiplier analysis.

Specification and analysis of a growth scenario for the region is presented in Chapter 4. The scenario is based upon growth projections of the four most volatile sectors of the regional economy: government, livestock production, food processing and electronics and precision instruments. A sensitivity

analysis of total economic forecast is conducted. Finally, the forecasts of
dollar output are interpreted in terms of increased employment on a basis com-
patible with the State Division of Planning's population projections.

Finally, Chapter 5 contains a summary of major findings, a statement of
the limitations of the study and comments regarding future efforts to update,
improve and utilize the model.

Under separate cover are included a technical report describing the input-
output model and the computer operation. These components of the report are
not essential, but have been included for the benefit of those who may wish to
conduct further study using the interindustry framework.

CHAPTER 2

CALIBRATION OF THE INPUT-OUTPUT MODEL

The purpose of this chapter is to describe the assembly of data required for the calibration of the Larimer-Weld Regional Input-Output Model. The chapter contains three sections: (1) sectoring the regional economy, (2) description of the sector, and (3) a description of data sources.

Sectoring the Regional Economy

The input-output model requires the division of the economy into various economic sectors. An economic sector is an aggregation of individual firms into one category. For example, the food processing sector consists of firms engaged in the processing of livestock, fruits and vegetables, sugar, dairy products and various food and feed grains. Total output, by input-output accounting procedures, is the combined value of all sales that take place in the specified time period. Total output is specified for each sector in order to study the structural interdependence that prevails. Economic activity is divided into two major components, suppliers (sellers) and purchasers (users). Each of these is further subdivided as follows: suppliers include: (1) intermediate or processing suppliers who are producers and who must purchase inputs to be processed into outputs which are sold either to other processors or directly to final users, and (2) primary suppliers whose output does not directly depend on purchased inputs. Purchasers include: (1) intermediate or processing purchasers who buy the outputs of suppliers for use in further processing, and (2) final purchasers

who buy the outputs of suppliers in final form and for final use. The level
of demand by final purchasers, and the composition of final demand are both
determined exogenously (or outside the input-output system). Primary suppliers
and final purchasers may or may not be one and the same. The activities of
the two are treated as if they were completely independent of each other.
The two major divisions of suppliers are then intermediate suppliers (termed
processors), and final suppliers (designated as the final payments sector).
The two major divisions of purchasers are intermediate purchasers (termed,
again, processors) and final purchasers (designated as the final demands
sector). It is within this general framework that a further sector disaggre-
gation must be accomplished.

An ideal disaggregation within the broad categories outlined above
would consist of industries or producer groups which provide a homogeneous
good or service. This ideal, however, is very difficult to achieve due to
the lack of sufficient data and the limitations of time and money for data
collection and disaggregation. Therefore, some compromise is often necessary.

Sector selection also depends upon the objectives of the study. The
present study is particularly concerned with providing a tool for projecting
long-run economic trends and forecasting the economic impacts of exogenous
policy decisions. For this reason the sector classifications attempt to
define the major components of the region's economy.

The sectors of the study were defined in accordance with the Standard
Industrial Classifications of 1972. In some cases aggregation across the
SIC numbers was made either because of disclosure rules or because some
sectors had a minimal amount of activity in the two-county region. In other
cases, SIC numbers were ignored due to the lack of any activity in that
sector in this region. Table III-1 presents the sectors identified in the
study and the corresponding SIC numbers.

TABLE II-1:   SECTOR IDENTIFICATION BY STANDARD INDUSTRIAL CLASSIFICATION

Sector Numbers	Sector Name	1972 SIC Codes
1	Livestock and livestock products	02
2	Irrigated agriculture	01
3	Dryland agriculture	01
4	Food and kindred products	20
5	Mining and extraction	10-14; 32
6	Metals and electronic components	19, 2514, 2515, 2522, 2542, 2591, 2599, 33, 34-38
7	Paper and allied products	26
8	Printing and publishing	27
9	Chemicals and petroleum	28-30
10	Lumber and wood products	24, 2511, 2512, 2519, 2521, 2531, 2541
11	Miscellaneous manufacturing	21, 22, 23, 31, 39
12	Utilities, transportation, and communication	40-49
13	Services	07-09; 70-81; 84-89
14	Wholesale and retail trade	50-59
15	Education	82 and public
16	Households	

The final demand and payments sectors are not shown in Table III-1. The final demand sector consists of local, state and federal governments (excluding education), investment or gross private capital formation, inventory change, and exports. The final payments sector consists of local, state and federal governments (excluding education), construction, depreciation, rents, interest, dividends, finance, insurance, real estate, and imports. Because of incomplete data in certain sectors, a miscellaneous sector was included in both the final demand and final payments portions of the transactions table.

Description of Sectors

The study identifies sixteen economic sectors. These sectors consist of single, multiple and, in one case, a disaggregated Standard Industrial Classification. Sectors with a multiple of SIC numbers were necessitated by disclosure rules which do not allow publication of data that can be attributed to a particular firm. Aggregation was also performed for SIC designations with limited economic activity. The agricultural sector is disaggregated into three sectors. Many input-output studies treat this as a single sector. However, given the important role of agriculture in this region and the fact that it is the single most important water user in the area, this sector has been disaggregated into a livestock and livestock products sector, an irrigated agriculture sector and a dryland agriculture sector.

Sector 1: Livestock and Livestock Products. This sector consists of all beef cattle and calves, dairy cattle and calves, hogs, sheep, goats, horses, poultry, and all nonprocessed products of livestock. The major component of this sector in this region is beef cattle. The bulk of this sector is in Weld County, with Monfort and Farr Farms representing the largest firms.

Sector 2: Irrigated Agriculture. This sector consists of a number of crops produced in the region. As can be seen from Table III-2, some of these crops are grown with both irrigation and without irrigation. Principal among the irrigated crops in terms of total acreage are corn grain, corn silage, oats, hay, sugar beets and dry beans. In 1974, irrigated acreage in the two counties produced 52 percent of the state's corn silage, 41 percent of its sugar beets, 34 percent of its dry beans, 22 percent of its barley, 17 percent of its corn grain, 16 percent of its hay, and 9 percent of its potatoes.

Sector 3: Dryland Agriculture. This sector also includes a number of crops which are produced in the region as shown in Table III-2. Principal among these in terms of total acreage is winter wheat. In 1974, the two-county acreage planted in winter wheat represented nearly 8 percent of the state total and produced 9.5 percent of the state's total winter wheat output.

Sector 4: Food and Kindred Products. The food processing sector includes meat packing plants, prepared meat products, processing of diary products, prepared animal feed, cereal preparations, fruit and vegetable processing, bakery products, sugar production and beverage manufacturing. This sector is relatively large in the two-county area due to the existence of well-developed livestock and agricultural crops sectors. Beef processing by Monforts and sugar beet processing by Great Western represent the two largest firms in this sector.

Sector 5: Mining and Extraction. This sector is very small in Larimer and Weld Counties. As a result of disclosure problems, it was necessary to aggregate this sector with the stone, clay, and glass products sector. Thus, this sector includes all enterprises engaged in mining operations and those engaged in manufacturing structural clay products, cement, cut stone products, abrasive and asbestos products, concrete and gypsum products

TABLE II-2: ACREAGE AND PRODUCTION OF IRRIGATED AND NON-IRRIGATED CROPS BY COUNTY, 1974

| | IRRIGATED | | | | | | NON-IRRIGATED | | | | | |
| | Acreage | | | Production | | | Acreage | | | Production | | |
Crop	Larimer	Weld	Total	Larimer	Weld	Total	Larimer	Weld	Total	Larimer	Weld	Total
Winter Wheat	1,300	3,400	4,700	61,100 bu	136,000 bu	197,100 bu	12,200	195,600	207,800	317,200 bu	4,303,000 bu	4,828,000 bu
Corn Grain	9,000	66,000	75,000	900,000 bu	7,458,000 bu	8,358,000 bu	-	1,500	1,500	-	24,000 bu	24,000 bu
Barley	11,000	18,000	29,000	660,000 bu	1,188,000 bu	1,848,000 bu	3,000	9,500	12,500	99,000 bu	237,500 bu	336,500 bu
Sorghum Grain	-	500	500	-	37,500 bu	37,500 bu	-	400	400	-	301,000 bu	301,000 hu
Dry Beans	3,800	18,700	22,500	72,200 cwt	355,200 cwt	427,400 cwt	-	800	800	-	4,000 cwt	4,000 cwt
Sugar Beets	6,000	41,000	47,000	116,000 tons	803,000 tons	919,000 tons	-	-	-	-	-	-
Hay	53,000	100,000	153,000	126,800 tons	287,000 tons	413,800 tons	-	-	-	-	-	-
Oats	1,000	2,500	3,500	70,000 bu	187,000 bu	257,000 bu	100	3,800	3,900	3,000 bu	95,600 bu	98,600 bu
Corn Silage	23,100	89,600	112,700	460,000 tons	1,867,000 tons	2,327,000 tons	-	-	-	-	-	-
Spring Wheat	800	800	1,600	26,400 bu	28,800 bu	55,200 bu	300	400	700	5,100 bu	9,200 bu	14,300 bu
Potatoes	-	3,550	3,550	-	952,000 cwt	952,000 cwt	-	-	-	-	-	-

from materials taken from the earth in the form of stone, clay and sand.

Sector 6: Metals and Electronic Components. This sector also represents an aggregation of sectors made necessary by disclosure laws. The sector consists of primary metals, fabricated metals and machinery, and electronic components and precision equipment. Within this sector, the major firms are Kodak, Hewlett-Packard, Teledyne Water Pic, and Woodward Governor.

Sector 7: Paper and Allied Products. This sector includes the manufacturing of pulp from wood and other cellulose fibers, the manufacturing of paper and paperboard, and the manufacturing of paper bags, boxes and envelopes. It is a relatively small sector in this region.

Sector 8: Printing and Publishing. The printing and publishing sector includes enterprises engaged in printing and those enterprises such as bookbinding, typesetting, engraving, photoengraving, and electrotyping which perform services for the printing trade. The largest firms in this sector are represented by the local newspaper publishers.

Sector 9: Chemicals, Explosives, Petroleum and Rubber. This sector includes enterprises which manufacture basic chemical products to be used in further manufacturing such as synthetic fibers, plastic materials (including explosives and ammunition), finished chemicals such as drugs, cosmetics and soaps. The sector also includes petroleum refining, manufacturing of paving and roofing materials, natural synthetic or reclaimed rubber products, and enterprises engaged in molding primary plastics and manufacturing miscellaneous plastic products.

Sector 10: Lumber and Wood Products. This sector includes enterprises which manufacture wood furniture and fixtures as well as logging operations engaged in cutting timber and pulpwood, merchant sawmills, lath mills, shingle mills, plywood and veneer mills engaged in producing lumber and wood basic materials. Also, this sector includes all establishments engaged

in manufacturing finished articles made entirely or mainly of wood or wood substitutes.

Sector 11: Miscellaneous Manufacturing. This sector is a residual manufacturing sector containing textile products, leather products, and apparel. It also includes cigarette manufacturing and other tobacco products, sporting goods, musical instruments, silverware and other plated ware, toys, pens, pencils, costume novelties, and other miscellaneous manufacturing industries.

Sector 12: Transportation, Communication and Public Utilities. This sector includes all enterprises providing passenger and freight transportation by rail, highway or air, or services related to transportation. Also included are petroleum pipeline transportation, warehousing, telephone and telegraph communication services, and radio and television broadcasting. The final component of the sector consists of operations supplying electricity, gas, water, and sanitary services.

Sector 13: Services. The service sector includes enterprises performing agricultural, animal husbandry, and horticultural services on a fee or contractual basis, hotels and other lodging places and establishments providing personal, business, repair and amusement services. It also includes medical, legal, engineering and other professional services as well as nonprofit membership organizations and other miscellaneous services, excluding educational services.

Sector 14: Wholesale and Retail Trade. This sector consists of establishments primarily selling merchandise to retailers, to industrial, commercial, institutional and professional users and to other wholesalers. It also includes establishments selling merchandise for personal, household, or farm consumption and which render services incidental to the sale of goods.

Sector 15: Education. The education sector includes public and private institutions which provide formal academic and/or technical courses, correspondence schools, commercial and trade schools, and libraries. Schools for beauticians, beauty shops and barber colleges are included in the services sector. Largest single institutions in this sector for this region are Colorado State University and the University of Northern Colorado.

Sector 16: Households. The household sector is treated as a portion of the processing sector (i.e., as an endogenous sector). Household incomes includes wages, interest payments and salaries. Household purchases in general are the revenues accruing to the firm which are not obtained through the sale of goods and services to governments, to foreign markets or to other intermediate users. Thus, the household is the final individual consumer.

Data Sources

The base year for this study is 1974. This is the most recent year for which data are complete. Numerous census sources as well as other local, state and federal government data publications are utilized to estimate the control totals (i.e., total value of shipments) for the various sectors. These are listed in the references. In all cases, these estimates are cross-checked two or three times against different data sources.

Direct production coefficients were utilized from a 1970 input-output study of Boulder, Larimer, and Weld Counties.[7] At the time, these coefficients were developed through direct surveying of the various enterprises in each sector of the economy.

The 1970 coefficients were utilized to distribute the control totals in order to develop the commodity flows among the producing sectors. This

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[7] S. L. Gray and J. R. McKean, Economic Analysis of Water Use in Boulder, Larimer and Weld Counties, Colorado, With Projections to 1980. Colorado State Experiment Station General Series 953, Fort Collins, Colorado, April, 1976.

procedure significantly reduced the total cost of this study by limiting the necessity of primary data collection through interviews and questionnaires. Furthermore, no major technological changes are obvious for this period so that these coefficients are expected to be accurate depictions of current operations.

Finally, some primary data was collected from several sources. Kodak was not included in the 1970 model, since it was not in full operation at the time. Kodak was contacted for this study in order to assess the adequacy of the existing data to represent the sectors. Furthermore, in order to make projections, it was necessary to interview directly some of the major firms such as Hewlett-Packard, Teledyne Water Pic, Woodward Governor, Monforts and Farr Farms. Governments were surveyed by the Larimer-Weld Council of Governments to assess their future growth and the Cooperative Extension Service provided information on future prospects in agriculture.

CHAPTER 3

THE REGIONAL ECONOMY: DESCRIPTION AND ANALYSIS

This chapter presents the descriptive analysis of the Larimer and Weld regional economy. Included in the presentation are: (1) the description of the estimated dollar value of transactions among sectors of the regional economy for the base year 1974; (2) the analysis of the nature and magnitude of economic interdependence among producing sectors; (3) estimated business activity multipliers, income multipliers and employment multipliers; and (4) the analysis of 1974 income and employment.

The Descriptive Analysis

Description of economic activity in the regional economy rests upon the construction of three primary tables necessary to the input-output format. These are termed the transactions table, the table of direct production requirements and the table of direct plus indirect production requirements. These three tables are quite closely related but each serves to describe relationships among sectors in a different manner. Each table is discussed in turn.

The Transactions Table. The key to the input-output system is the construction of the transactions table (or gross flows table) shown in Table III-1. Depicted in the table are the estimated dollar value of the flows of goods and services between each of the producing sectors identified and flows to and from the final demands and final payments components. The

table thus serves to describe, simultaneously, the distribution of output to intermediate and final demands and the purchases made by each sector in order for production to take place. The transactions table may be conveniently divided into several major components. The rows and columns of Table III-1 numbered 1 through 16 constitute the processing sector of the economy.[8/] The transactions contained in the processing sector describe the dollar value of goods and services which are used to satisfy intermediate demands. In addition to the processing sectors, Table III-1 contains several columns and rows which comprise the final demand and final payments sectors of the economy. The final demand sectors of the present study (columns 17, 18, and 19) include deliveries of commodities to the governments sector, which includes all levels of governments, deliveries to export markets and deliveries to other final demand such as private capital formation (invest-ment), finance, insurance and real estate, net inventory change and other items not allocated to specific sectors of the economy. The final payments sector (rows 17, 18 and 19) consist of payments in the form of taxes to all levels of governments, payments for imported goods and services, and other final payments which include construction, depreciation, finance, insurance and real estate, personal savings and the unallocated expenditure by each sector.

The final row and column of the table are respectively the total outlay and total output of each sector of the regional economy. The row entries are the sums of the respective columns while the column entries are the

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[8/] The households sector may be included either as a processing sector or as a component of final demand. For purposes of estimating the various multiplier impacts, including the induced impacts of additional household consumption, it is desirable and necessary to include households within the processing sector.

TABLE III-1: TRANSACTIONS TABLE, LARIMER-WELD REGIONAL ECONOMY, 1974

(in millions of dollars)

	1 Livestock	2 Irrigated Agriculture	3 Dryland Agriculture	4 Food Processing	5 Mining	6 Metals and Electronics	7 Paper	8 Printing	9 Chemicals and Petroleum	10 Lumber and Wood	11 Miscellaneous Manufacturing	12 Utilities	13 Services	14 Trade	15 Education	16 Households	17 Government	18 Exports	19 Other Final Demand	20 Total Gross Output
1 Livestock	50.07	1.75	1.36	381.14											.25	4.37		38.49	.21	477.64
2 Irrigated Agriculture	51.98	6.03	.49	26.94											.07	1.46	1.34	35.30	4.62	128.23
3 Dryland Agriculture	3.53			1.62													2.19	8.93	1.09	17.48
4 Food Processing	22.01	.64	.05	1.05									.28	9.25	.94	8.87		751.86	14.78	809.73
5 Mining						.21			.02		.03	.12			.02	.97	.70	23.33	1.16	36.21
6 Metals and Electronics				.65	.31	4.07		.01	.11		.12				.29	.24	11.16	372.66	16.48	406.56
7 Paper				.40		.08									.07		.16	1.35	.91	2.70
8 Printing				.08	.05	1.05		.03								1.34	.01			10.70
9 Chemicals and Petroleum	3.30	.16	.08			.84			.04		.34	.36	.60	5.79	1.06	.56	.43		.02	5.11
10 Lumber and Wood					.12	.66	.39			1.98	.02	.01	.02		.11	3.50	.50		5.25	11.96
11 Miscellaneous Manufacturing				1.81		.53		.20			.01	.04	.09	1.20	.11	5.58	.88	3.57		18.65
12 Utilities	7.11	1.91	.54	8.17	.54	18.50	.05		.11	.04	.90	.01	7.09	29.79	.09	12.73	11.77	2.20	.01	177.42
13 Services	15.51	5.99	1.83	.49	9.14	1.69	.80	.21	.06	.54	.59	7.09	13.00	59.99	4.29	72.91	5.67			223.81
14 Trade	5.11	13.46	1.84	1.70	1.39	1.40	.09	.06	.04	.04	.15	1.17	11.88	107.44	1.21	59.90	6.08	55.12	2.46	994.20
15 Education	.19					1.82						.66	2.90	.14	2.25	75.58	98.81	384.40	88.20	180.86
16 Households	35.94	5.41	.94	33.78	13.22	75.29	.50	4.86	.56	3.50	5.58	24.75	69.30	144.55	103.91	377.05	159.34	2.05	.19	1,240.68
17 Government	10.07	2.71	.48	40.53	1.94	38.74		.59	.43	.50	.88	9.28	10.33	23.04	.05	129.96		54.68	504.14	360.35
18 Other Final Payments and Unallocated	2.13	50.88	8.97	10.29	2.46	17.74		1.24	.86	.03	2.17	31.06	39.62	145.85	7.61	165.05	55.64	157.10	95.11	750.17
19 Imports	273.85	36.15	.82	301.00	7.01	243.94	.80	3.50	2.86	4.74	7.86	102.92	74.34	467.16	57.90	329.76	10.52	162.38		2,220.20
20 Total Gross Output	477.64	128.23	17.48	809.73	36.21	406.56	2.70	10.70	5.11	11.96	18.65	177.42	223.81	994.20	180.86	1,240.68	360.35	1,891.04	1,029.70	8,072.66

sums of the respective rows. It is noted that the column sum and the row sum for any specific sector within the processing portion of the table are equal. This states, quite simply, that total value of purchases equals the total value of production, a requirement of the double entry system of book-keeping which is employed. This same balance requirement is not imposed on specific components of the final demands and final payments sectors. One would not expect to find, for example, equality between government spending and government revenues for small regional economies nor would one expect a balance between exports and imports. All that is required is that, in aggregate, final demands equal final payments.

Discussion and interpretation of the transactions table may be facili-tated by considering the transactions of a specific sector. Consider sector 4, food processing. The total value of sales for this sector as of 1974 was estimated at $809.73 million. Reading across row 4 of Table III-1 indicates that $22.01 million worth of processed foods and/or feeds were sold to the livestock sector, $0.64 million to irrigated agriculture, $0.05 million to dryland agriculture, $1.05 million to food processing, $0.28 to services, $9.25 million to retail and wholesale trade, $0.94 million to education, and $8.87 to households. These entries comprise the distribution of processed foods to the intermediate demands sectors. In addition, $751.86 million worth of output from the food processing sector was sold in markets outside the two-county area and $14.78 million was sold to other final demand sectors. On the purchases side, an examination of column 4 reveals that the food processing sector purchased $381.14 million worth of output from the livestock sector, $26.94 million from irrigated agriculture, $1.62 million from dryland agriculture, $1.05 million from food processing and so on down the column. In addition to the purchases from other producers, food processing made payments of $40.53 million to governments, imported $301 million worth of goods from

outside the area and made other final payments of $10.29 million. The other rows and columns of Table III-1 are interpreted in the same fashion.

The row and column totals may be used to provide one indication of the relative importance of individual sectors in the two-county regional economy. The agricultural sectors and food processing as a related sector account for a total of $1.43 billion worth of output or 31.11 percent of the total value of output in the 16 processing sectors. If household income is excluded from the processing sectors then this percent share of total output held by the agricultural sector increases to 42.57 percent. The largest single sector, again excluding household income, is the wholesale and retail trade sector with 1974 sales estimated at $994.2 million. This is followed by food processing, $809.73 million; livestock, $477.64 million; electronics and precision instruments, $406.56 million; services, $223.81 million; education, $180.86 million; utilities, transportation, and communication, $177.42 million; and irrigated agriculture, $128.23 million.

Another direct indicator of the relative importance of particular sectors to the economic activity of a region is the contribution made to household income (or payments for labor services). Wholesale and retail trade emerges as the processing sector providing the greatest dollar payment to the household sector with 1974 payments estimated at $144.55 million. Other leading sectors are: education, $103.91 million; metals, electronics and precision instruments, $75.29 million; services, $69.30 million; livestock, $35.94 million; food processing, $33.78 million; and utilities, transportation and communication, $24.75 million. When payments to the household sector by final demands sectors are included in the discussion, two large entries are noted. Government, as would be expected, contributes a large payment for household services, estimated at $159.34 million. The entry in the other final demand column and household row is a very large entry which reflects

not only payments made to households by sectors such as construction, finance, insurance and real estate, but also all other household income such as unearned income. This entry of $504.14 million is a residual obtained by subtracting the sum of all payments to households by processors and governments from the estimated total household income of $1,240.68 million.

Estimates of gross regional income and gross regional product may also be obtained from the transactions table. Gross regional product is approximated by the sum of deliveries to final demand net of imports. In the two counties, 1974 gross regional product was estimated to be $1,110.52 million. Gross regional income is computed directly from the final payments sector of Table III-1 and is, by definition, identical to gross regional product. Estimation of gross regional income is accomplished by summing all entries in the final payments sector, net of imports. The result, $1,110.52 million, shows that the equality between gross regional product and gross regional income has been preserved. The leading sectors contributing to gross regional income are: trade, $168.89 million; aggregate agricultural sectors, $75.24 million; electronics and precision instruments, $56.48 million; food processing, $50.82 million; services, $49.95 million; and utilities, $40.34 million.

It will be noted from the transactions table that the Larimer-Weld regional economy is, on balance, a net importer of goods produced outside the region. Imports exceed exports by some $329.16 million. However, certain key sectors, such as food processing and metals and electronic components, are currently large net export sectors and others, such as trade and services, are nearing a balance. As economic development continues, it is likely that the balance may shift toward net export.

The Table of Direct Production Requirements. The second essential component of input-output analysis is the direct (or technical) coefficients table, Table III-2. This table shows the direct production requirements

TABLE III-2: DIRECT INPUT OR TECHNICAL COEFFICIENTS MATRIX

Columns 1–10

	1 LIVESTOCK	2 IRR. AG.	3 DRYLAND AG	4 FOOD PROC.	5 EXTRACT.	6 ELCTRONICS	7 PAPER	8 PRINTING	9 CHFM.PET.	10 LUMBER
1 LIVESTOCK	.104828	.013647	.077803	.470700	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2 IRR.AG.	.108827	.047025	.028032	.033270	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
3 DRYLAND AG	.007391	0.000000	0.000000	.002001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
4 FOOD PROC.	.046081	.004991	.002860	.001297	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5 EXTRACT.	0.000000	0.000000	0.000000	.000803	.252416	.000517	0.000000	0.000000	.021526	.049331
6 ELCTRONICS	0.000000	0.000000	0.000000	.000494	.008561	.010011	0.000000	.000935	0.000000	0.000000
7 PAPER	0.000000	0.000000	0.000000	.000099	.001381	.000197	0.000000	0.000000	.003914	0.000000
8 PRINTING	0.000000	0.000000	0.000000	.000099	.000829	.002583	0.000000	.002804	.003914	0.000000
9 CHEM.PET.	.000293	.025735	.009153	0.000000	.003314	.002066	.144444	0.000000	.007828	0.000000
10 LUMBER	0.000000	0.000000	0.000000	0.000000	0.000000	.001623	0.000000	0.000000	0.000000	.165552
11 MISC.MFG.	0.000000	0.000000	0.000000	.002235	0.000000	.001304	0.000000	0.000000	.021526	.003344
12 UTILITIES	.014886	.014895	.030892	.010090	.014913	.045504	.018519	.018692	.011742	.045151
13 SERVICES	.032472	.104958	.104691	.000605	0.000000	.004157	.025926	.019626	.007828	.003344
14 TRADE	.010698	.042190	.105263	.002099	.038387	.003444	0.000000	.005607	0.000000	0.000000
15 EDUCATION	.000398	.021134	.053776	0.000000	0.000000	.004477	0.000000	0.000000	.109589	0.000000
16 HOUSEHOLDS	.075245	.396787	.027460	.041718	.365093	.185188	.296296	.454206	.084149	.292642
17 GOVERNMENT	.021083	0.000000	.513158	.050054	.053576	.095287	.033333	.055140	.168297	.041806
18 OTHER F P	.004459	0.000000	0.000000	.012708	.067937	.043634	.185185	.115888	0.000000	.007508
19 IMPORTS	.573340	.281915	.046911	.371729	.193593	.500010	.296296	.327103	.559687	.396321

Columns 11–19

	11 MISC.MFG.	12 UTILITES	13 SERVICES	14 TRADE	15 EDUCATION	16 HOUSEHOLDS	17 GOVERNMENT	18 EXPORTS	19 OTHER F D
1 LIVESTOCK	0.000000	0.000000	0.000000	0.000000	.001382	.003522	0.000000	.020354	.000204
2 IRR.AG.	0.000000	0.000000	0.000000	0.000000	.000387	.001177	.003268	.018667	.004487
3 DRYLAND AG	0.000000	0.000000	0.000000	0.000000	0.000000	.000097	.005342	.004722	.001059
4 FOOD PROC.	0.000000	0.000000	.001251	.009304	.005197	.007149	0.000000	.397591	.014354
5 EXTRACT.	.001609	0.000000	0.000000	0.000000	.000111	.000782	.001707	.012337	.001127
6 ELCTRONICS	.006434	.000676	0.000000	0.000000	.001603	.000193	.027221	.197046	.016005
7 PAPER	0.000000	0.000000	0.000000	0.000000	.000387	0.000000	.000390	.000714	.000884
8 PRINTING	.018231	.002029	.002681	.005824	.005861	.001080	0.000000	0.000000	0.000000
9 CHEM.PET.	0.000000	.000056	0.000000	0.000000	.000608	0.000000	0.000000	.000019	.000019
10 LUMBER	.001072	0.000000	.000402	0.000000	.000608	.000193	.000193	.001888	.005099
11 MISC.MFG.	.000536	.039962	.000089	.001207	.000498	.010261	.000024	.001163	.000010
12 UTILITIES	.048257	.058085	.006595	.029964	.023690	.058766	.028709	.029148	.002389
13 SERVICES	.031635	.006595	.053081	.060340	.006690	.048280	.013830	.029148	.002389
14 TRADE	.008043	.003720	.012957	.108067	.012441	.303906	.014830	.203274	.085656
15 EDUCATION	0.000000	0.000000	.006479	.000141	.003483	.060918	.241012	.001084	.000185
16 HOUSEHOLDS	.299196	.139499	.309638	.145393	.574533	.000105	.388653	.028915	.489599
17 GOVERNMENT	.047185	.052305	.046155	.023174	.000105	.133032	.135714	0.000000	.092367
18 OTHER F P	.116354	.175065	.177025	.146701	.042077	.104749	.113640	.083076	.092367
19 IMPORTS	.421448	.580092	.321570	.469885	.320137	.265790	.025660	0.000000	.286559

necessary for each dollar's worth of output in any of the designated producing sectors. The elements of Table III-2, as explained in Chapter 2 of this report, are derived by dividing the entries in each column of the transactions table, Table III-1, by the respective column totals. The results, presented in Table III-2, describe the direct requirements from each sector at the left of the table in order for the sector at the column head to produce one dollar's worth of output.

For purposes of interpretation, consider the entries in column 1 of Table III-2. For every dollar's worth of output in the livestock sector of the regional economy, the livestock sector must purchase $0.10 worth of product from itself, $0.11 from irrigated agriculture, $0.01 from dryland agriculture, $0.05 from food processing, $0.01 from utilities, $0.03 from services, $0.01 from trade, and $0.08 from households. The total direct purchases by the livestock sector from local processing sectors in order to produce one dollar's worth of output in the livestock sector is thus $0.40. The remaining $0.60 is accounted for in the final payments (exogenous) sector. Each of the remaining columns of Table III-2 is interpreted in this manner. These direct production impacts show the "first round" impacts of some changes in the final demand sectors of the economy. The direct impacts, however, represent only a portion of the total impacts of such disturbance and are thus of limited usefulness. Indirect impacts also exist and may be quite significant depending upon the degree of interdependence among the various processing sectors. The third analytical component of the accounting system provides the means for assessing the nature and magnitude of the economic interdependencies and measures the total direct and indirect impacts of changes in final demand.

The Table of Direct Plus Indirect Production Coefficients. Table III-3, the table of direct and indirect production coefficients, is the third

TABLE III-3: DIRECT PLUS INDIRECT PRODUCTION COEFFICIENTS

	1 LIVESTOCK	2 IRR. AG.	3 DRYLAND AG	4 FOOD PROC.	5 EXTRACT.	6 ELCTRONICS	7 PAPER	8 PRINTING	9 CHEM.PET.	10 LUMBER
1 LIVESTOCK	1.1497	.0210	.0936	.5433	.0061	.0024	.0039	.0054	.0015	.0043
2 IRR. AG.	.1337	1.0522	.0407	.0983	.0017	.0007	.0011	.0015	.0004	.0042
3 DRYLAND AG	.0086	.0002	1.0007	.0061	.0001	.0000	.0001	.0001	.0000	.0041
4 FOOD PROC.	.0556	.0086	.0103	1.0284	.0071	.0027	.0045	.0061	.0018	.0048
5 EXTRACT.	.0002	.0002	.0002	.0012	1.3383	.0010	.0004	.0006	.0002	.0005
6 ELCTRONICS	.0002	.0007	.0003	.0007	.0120	1.0104	.0034	.0012	.0224	.0040
7 PAPER	.0000	.0000	.0000	.0001	.0019	.0002	1.0000	.0000	.0000	.0000
8 PRINTING	.0009	.0000	.0018	.0009	.0039	.0037	.0023	1.0051	.0047	.0061
9 CHEM.PET.	.0039	.0015	.0103	.0028	.0048	.0022	.1451	.0001	1.0040	.0002
10 LUMBER	.0001	.0272	.0002	.0001	.0003	.0021	.0015	.0002	.0095	1.1907
11 MISC. MFG.	.0016	.0013	.0018	.0036	.0063	.0038	.0040	.0057	.0016	.0087
12 UTILITIES	.0356	.0332	.0577	.0329	.0693	.0670	.0532	.0633	.0348	.0495
13 SERVICES	.0594	.0689	.1353	.0354	.0473	.0225	.0316	.0613	.0244	.0371
14 TRADE	.0784	.1610	.1766	.0629	.2568	.0837	.1575	.1902	.0596	.1476
15 EDUCATION	.0092	.0068	.0099	.0078	.0358	.0188	.0228	.0331	.0092	.0247
16 HOUSEHOLDS	.1365	.1040	.1470	.1199	.5787	.2308	.3694	.5340	.1465	.4276

	11 MISC. MFG.	12 UTILITES	13 SERVICES	14 TRADE	15 EDUCATION	16 HOUSEHOLDS
1 LIVESTOCK	.0039	.0017	.0048	.0080	.0113	.0015
2 IRR. AG.	.0011	.0005	.0013	.0017	.0030	.0032
3 DRYLAND AG	.0001	.0000	.0001	.0001	.0002	.0002
4 FOOD PROC.	.0044	.0020	.0060	.0133	.0132	.0129
5 EXTRACT.	.0026	.0002	.0004	.0003	.0009	.0012
6 ELCTRONICS	.0068	.0008	.0003	.0002	.0020	.0005
7 PAPER	.0000	.0000	.0000	.0000	.0004	.0000
8 PRINTING	.0201	.0029	.0047	.0078	.0088	.0046
9 CHEM.PET.	.0001	.0001	.0001	.0001	.0008	.0001
10 LUMBER	.0014	.0001	.0006	.0001	.0010	.0004
11 MISC. MFG.	1.0046	.0018	.0044	.0038	.0078	.0123
12 UTILITIES	.0834	1.0558	.0959	.0576	.0795	.0904
13 SERVICES	.0631	.0204	1.0872	.0891	.0591	.0857
14 TRADE	.1399	.0633	.1514	1.1998	.2464	.3935
15 EDUCATION	.0236	.0106	.0312	.0145	1.0452	.0706
16 HOUSEHOLDS	.3780	.1713	.3945	.2245	.6748	1.1451

component of the input-output model. The information presented in this table addresses the following issue: suppose there is a change in one or all of the final demands for the output of one or more sectors in the regional economy. How does this change in final demand impact the entire economy? In other words, what is the total value of production generated in all sectors of the economy in order to sustain the desired delivery of output for final consumption? Consider column 4 of Table III-3. Assume that the export demand for processed foods increases by one million dollars. Reading down the column it is immediately seen that the output of the livestock sector must increase by .5433 x $1,000,000 or $543,300 in order to sustain the increase in final demand. Similarly, the value of output in irrigated agriculture will increase by $98,300; in dryland agriculture by $6,100; in food processing by $1,028,400 and so on down the column. In total, an increase of $1,000,000 in the final demand for processed foods will generate production valued at $1,944,400 throughout the regional economy. Thus, for the food processing sector a business activity or production multiplier of 1.9444 exists--for every dollar change in final demand for processed foods, $1.9444 worth of production is generated throughout the regional economy.

A less publicized, but potentially useful, piece of information may also be obtained by interpreting the rows of Table III-3. The issue addressed here is that of estimating the total direct plus indirect production generated in a single sector as all sectors of the economy simultaneously expand deliveries to final demand. Consider once again the food processing sector, this time examining row 4 rather than column 4. As the final demand for livestock increases by one dollar, the direct plus indirect production generated in the food processing sector is $0.0556. As the final demand for irrigated agricultural products expands by one dollar the total direct plus indirect production generated in food processing is $0.0086. These are

the first two entires in row 4 of Table III-3. The interpretation of the
remaining entries in row 4 is precisely the same; i.e., as the final demand
for the output of the sector at the column head increases by one dollar, the
direct plus indirect production generated in food processing is determined.
Summing the entries in row 4 gives the estimated total direct plus indirect
production generated in food processing if all final demands increase
simultaneously by one dollar. Final demands, obviously, need not change by
an equal amount. This causes no problems in addressing the question. For
example, suppose the final demands for livestock increase by $1,000 while
for irrigated agriculture they increase by $10,000. The total impact on
food processing output is (.0556 x $1,000) + (.0086 x $10,000) or $141.60.

The Multiplier Analysis

　　There are several types of multipliers which may be developed from the
descriptive analysis just completed. All of them depend directly upon the
derivation of Table III-3. Three multipliers will be developed: (1) the
business activity multipliers; (2) the income multipliers; and (3) the
employment multipliers.

　　Business Multipliers. The business multiplier for any single sector of
the regional economy is the sum of the appropriate column entries in Table
III-3. These column sums, or sector-by-sector business multipliers estimate
the total direct plus indirect business activity generated in the entire
economy for each dollar's worth of output delivered for final consumption
by a particular sector.[9]

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　　[9] It should be recognized that the inclusion of households in the
processing sector of the table yields an additional component to the
multipliers. The business multipliers show the impacts of additional
household income on household consumption and thus we have the direct
plus indirect plus induced business activity generated by the exogenous
change.

The business multipliers for the 15 processing sectors (excluding house-holds) are presented in Table III-4. Two multipliers are given for each sector. The first column presents the multiplier effect representing only the direct plus indirect production generated by an increase of one dollar in deliveries to final demand. This column ignores the induced impact of increased house-hold income and increased spending. The second column includes the induced effect, in addition to the direct plus indirect impact, and is thus consis-tently larger than the first. The business multipliers in column 2 reflect the impact on the labor sector (households) associated with increased final demands. Thus, those sectors which have a large direct labor payment and/or which are heavily dependent upon labor intensive sectors for the ingredients of production will exhibit substantial induced impacts. As shown in Table III-4, including the induced effects of increased household spending can cause significant changes in the magnitude and rank ordering of the multipliers.

Several comments concerning these multipliers are in order. First, these multipliers are estimated for a relatively small regional economy. In general, small regional economies would be expected to rely quite heavily on imported goods and services. Also, large and well-developed sectors of the regional economy may be expected to service markets outside the region; i.e., to export sizable quantities of commodities. Cases in point are the livestock, food processing, irrigated agriculture, and electronics and precision instruments sectors. These sectors may well be more important in terms of overall state economy than the business multipliers for the regional economy indicate. This is due directly to the fact that as the economy's boundaries expand, a greater proportion of the sales and purchases are made locally and, corre-spondingly, a lesser reliance is placed on import and export markets.

Second, some sectors which are relatively small in terms of the dollar value of sales may exhibit relatively large business multipliers. This is

TABLE III-4: BUSINESS MULTIPLIERS, LARIMER-WELD REGIONAL ECONOMY, 1974

(in dollars of business activity per dollar
of output delivered to final demand)

Sector	Business Multiplier*		Rank*	
	(1)	(2)	(1)	(2)
Livestock	1.455	1.673	2	10
Irrigated Agriculture	1.321	1.487	6	12
Dryland Agriculture	1.451	1.686	3	9
Food Processing	1.752	1.944	1	4
Mining	1.444	2.370	4	1
Electronics	1.082	1.452	12	13
Paper	1.209	1.801	8	6
Printing	1.053	1.908	15	5
Chemicals and Petroleum	1.088	1.323	11	15
Lumber and Wood	1.329	2.013	5	3
Miscellaneous Manufacturing	1.128	1.733	10	8
Utilities	1.057	1.332	14	14
Services	1.152	1.783	9	7
Trade	1.261	1.621	7	11
Education	1.074	2.154	13	2

* Column (1) under "business multiplier" and "rank" reflect the situation in which households are excluded from the processing sectors. Columns (2) reflect the induced impacts of including households in the processing sectors.

attributed to the fact that these sectors operate locally on both the purchases and sales sides of the market and, as would be expected, show a greater inter-dependence than do larger sectors. Care must be taken in using the multipliers without considering the relative size of the sectors. For example, the business multiplier for food processing with the induced household effects included was estimated at 1.944. That for lumber and wood products in the two counties was estimated at 2.01. It is not legitimate to conclude that lumber and wood products is relatively more important to the regional economy than is food processing. Rather, the multipliers tell us that, at the margin, an equal increase in the dollar value of deliveries to final demand in the two sectors will result in a larger direct plus indirect plus induced impact attributed to the lumber and wood products sector. However, a one million dollar increase in final demand represents 11.3 percent of the total final demand in lumber and wood products. The same increase in the food processing sector is a mere 0.10 percent of the total final demand for food processing. Thus, to obtain an equal total impact, the final demand for lumber and wood products would have to be stimulated by 11 percent compared to a 0.10 percent stimulus in final demands for processed foods.

Third, there is not a general agreement as to whether or not is is more appropriate to include households in the processing sectors or to include the sector as a component of final demands. The arguments pro and con appear to us to be of equal merit. We have included multiplier estimates for both situations in all cases; the business multipliers, the income multipliers, and the employment multipliers. The difference between the two multiplier estimates in each case is simply that the multipliers developed with house-holds included as a processing sector reflect the induced impacts of increased household spending. The others omit this impact.

Income Multipliers. There are alternative ways to express income multipliers from input-output analysis. One of these alternatives expresses income impacts in terms of changes in final demand. The other expresses income impacts in terms of direct income changes in particular sectors. The first provides estimates of the direct and indirect income and direct plus indirect plus induced income resulting from a change in final demand. The estimates are consistent with the business multipliers of the previous section. The second alternative relates direct, indirect, and induced income changes to changes in direct income payments. For purposes of this study we confine the presentation of income multipliers to the former case.

As was the case in presenting the business multipliers, we offer two sets of income impacts in the present discussion. The first set has the households sector as an element in final demands. The second includes household as a member of the processing portion of the economy. The two sets of estimates are presented in Table III-5. Column 1 reflects the direct plus indirect income generated per dollar of output delivered to final demand by each sector. Column 2 reflects the direct plus indirect plus induced income generated per dollar of output delivered to final demand, again for each sector.

The income impacts presented in Table III-5 indicate the income generated at the margin, throughout the economy, in response to a dollar's worth of product delivered to final demand by each sector. Thus, as the education sector increases; e.g., its education of non-local students or increases research funded by a government entity in an amount equal to $1,000 a total of $675 worth of income will be paid in the local economy. Of this amount, $574 is paid directly to employees in the education sector (see Table III-2

TABLE III-5: DIRECT PLUS INDIRECT AND DIRECT PLUS INDIRECT PLUS
INDUCED INCOME PER DOLLAR OF OUTPUT DELIVERED TO
FINAL DEMAND, LARIMER-WELD REGIONAL ECONOMY, 1974.

(in dollars of income per dollar final demand)

Sector	(1) Direct Plus Indirect Income	Rank	(2) Direct Plus Indirect Plus Induced Income
Livestock	.119	13	.136
Irrigated Agriculture	.091	15	.103
Dryland Agriculture	.129	12	.147
Food Processing	.105	14	.120
Mining	.506	2	.579
Electronics	.284	8	.313
Paper	.322	7	.369
Printing	.466	3	.534
Chemicals and Petroleum	.130	11	.149
Lumber and Wood	.378	4	.433
Miscellaneous Manufacturing	.330	6	.378
Utilities	.149	10	.171
Services	.345	5	.395
Trade	.195	9	.224
Education	.590	1	.675

for the direct income coefficient) and $101 worth of income is paid elsewhere in the economy. Again, care must be exercised in using these numbers. The food processing sector shows a direct plus indirect plus induced income impact of $.120 per dollar delivered to final demand. Comparing this with the mining sector indicates that the income impact in mining is 4.8 times as great as that for food processing. These are marginal impacts. A one million dollar increase in final demands in mining would constitute approximately 4 percent of total deliveries to final demand and would generate $579,000 worth of income in the economy. In order to generate the same income through the food processing sector, final demands for processed foods would have to increase by $4,825,000. This is, however, a mere .6 percent of the final demands for processed foods. On a percentage increase basis the final demands for mining sector outputs would have to increase by 7 times the percent increase in final demands for processed foods in order to gain the same increase in income.

The Employment Impacts. As was the case with income multipliers, alternative ways of expressing employment multipliers may be found. The two major alternatives are to: express the multiplier impacts in terms of employment generated per dollar of output delivered to final demand, by sector; express these impacts as a ratio of total employment to direct employment. The first of these is the one selected for use in this study.

Employment data in all but the agricultural sectors, (livestock, irrigated agriculture, and dryland agriculture) the household sector, and the education sector were obtained directly from the Colorado Division of Employment, by county and by standard industrial classification. These data are based upon employment in the fourth quarter of 1973 and the first three quarters of 1974. The employment coefficients employed in the

TABLE III-6: TOTAL EMPLOYMENT AND EMPLOYMENT PER $1,000
OF TOTAL OUTPUT, LARIMER-WELD REGIONAL
ECONOMY, 1974 [1]

Sector	Total Employment	Employment Per $1,000 Output
Livestock	7,165	.015
Irrigated Agriculture	7,950	.062
Dryland Agriculture	559	.032
Food Processing	3,402	.004
Mining	1,159	.032
Electronics	6,884	.017
Paper	133	.049
Printing	645	.060
Chemicals and Petroleum	100	.020
Lumber and Wood	431	.036
Miscellaneous Manufacturing	867	.046
Utilities	2,531	.014
Services	7,540	.034
Trade	14,243	.014
Education	17,905	.099
Households	124	.0001
Total	71,638	

[1] The total employment does not include employment in the final
demand sectors including governmnets, finance, insurance, real estate,
and construction.

following analysis are in terms of numbers of workers per $1,000 of total output and are presented in Table III-6. Employment in the irrigated and dryland agricultural sectors is based upon output per worker ratios for the state. Employment in education is based upon a previous sample of educational institutions in the region, including both higher education and elementary and secondary education.

The direct employment coefficients and correspondingly the total output estimates provide an indication of the major employing sectors in the two-county economy. The education sector, which includes Colorado State University, The University of NorthernColorado, and Aimes College, as well as the primary and secondary schools in the region, not unexpectedly emerges as the largest employer in the processing sector with 17,905 employees in 1974. The employment coefficient, 0.099, indicates a relatively high labor intensity compared with most other sectors and is the highest labor coefficient of any sector. Other major employing sectors are: trade, 14,243; irrigated agriculture, 7,950; services, 7,540; livestock, 7,214; electronics and precision instruments, 6,884; food processing, 3,402; and utilities, transportation, and communication, 2,531.

These direct employment figures and the accompanying direct labor coefficients are of limited usefulness in assessing the total impact of exogenous changes in final demand on employment in the region. The direct coefficients, as the terminology implies, address only direct employment impacts and ignore the fact of sectoral interdependence. Thus it is desirable to develop direct and indirect and direct, indirect and induced employment impacts to develop employment impacts which parallel the income impacts of the preceeding discussion.

Table III-7 presents the direct plus indirect and direct plus indirect plus induced employment coefficients per $1,000 worth of output delivered to final demand for each sector.

TABLE III-7: DIRECT PLUS INDIRECT AND DIRECT PLUS INDIRECT PLUS
INDUCED EMPLOYMENT, LARIMER-WELD REGIONAL ECONOMY, 1974

(in number of workers per $1,000 delivered to final demand)

Sector	(1) Direct Plus Indirect Employment	Rank	(2) Direct Plus Indirect Plus Induced Employment
Livestock	.0286	10	.0308
Irrigated Agriculture	.0704	2	.0721
Dryland Agriculture	.0430	8	.0453
Food Processing	.0203	14	.0222
Mining	.0446	6	.0537
Electronics	.0189	13	.0226
Paper	.0529	4	.0588
Printing	.0613	3	.0698
Chemicals and Petroleum	.0220	11	.0243
Lumber	.0454	7	.0522
Miscellaneous Manufacturing	.0495	5	.0555
Utilities	.0151	15	.0171
Services	.0380	9	.0443
Trade	.0195	12	.0230
Education	.1009	1	.1115

The employment impacts shown in Table III-6 show the total employment generated, respectively, per $1,000 of output delivered to final demand with households as a member of final demand and the processing sector. They provide an indication of the sectors which will, at the margin, stimulate the greatest total employment per dollar increase in final demand. The education sector is the leading sector in terms of employment generated per increment to final demand. This is followed by irrigated agriculture, printing and publishing, miscellaneous manufacturing, lumber and wood products, and mining.

The interpretation of the entries in Table III-7 is quite straightforward. Consider the direct plus indirect plus induced employment generated in the education sector. As the final demand for education increases by $1,000, a total direct plus indirect plus induced employment of .1115 workers is generated. Thus an increase of $1,000,000 in the final demand for education will generate employment for a total of 112 workers throughout the regional economy. The remaining entries of Table III-7 have the same straightforward interpretation.

This concludes the descriptive analysis of the Larimer-Weld regional economy. We now turn to an assessment of the impacts of alternative future growth scenarios upon output, income, and employment in the regional economy.

CHAPTER 4

ECONOMIC GROWTH SCENARIO

While the primary purpose of this study was to develop an input-output model descriptive of the regional economy, it is important to recognize the utility of the model as a planning tool. Not only does the input-output model provide a comprehensive description of the regional economy, but it also provides a mechanism for projecting the consequences of a large array of exogenous events. These events may range from economic growth to infusions of disaster relief and rehabilitation money to water quality control measures to land use planning policies.

The purpose of this chapter is to demonstrate the planning utility of the input-output model by projecting the consequences of one of these scenarios--economic growth. This scenario is of particular interest to local planners, especially in relation to the population generated by such growth. It is important to realize, however, that the output of this scenario is simply a projection, not a forecast. The following analysis is of an "if . . . then" nature: if certain assumptions are made, then the scenario projects their consequences.

The input-output model can be used to construct reliable forecasts, but more attention to verifying the basic assumptions is necessary than has been the case in the following scenario. However, it is possible to test the sensitivity of the projections to errors in the initial assumptions and, thus, obtain a feel for the reliability of the projections. This procedure is followed in the growth scenario constructed.

The following discussion: (1) describes and analyzes the basic growth scenario, (2) tests the sensitivity of the projections of this scenario to errors in the assumptions, and (3) evaluates the utility of these projections as forecasts of future conditions.

Basic Growth Scenario

The use of the input-output model to project economic activity involves: (1) the projection of final demand to the future time period being considered, and (2) applying these final demand values to the direct plus indirect production requirements table to determine the projected level of economic activity. This procedure requires the important assumption that technical production coefficients remain constant. That is, unless projections of technical production changes can be made, it is necessary to assume that input substitutions and technological changes will not occur over the relevant time period.

The economic growth scenario constructed here also assumes that four basic sectors of the regional economy will generate the preponderance of growth. The livestock, food processing, electronics, and government sectors are assumed to be the most volatile sectors for generating future growth. Weighted growth estimates computed directly from information obtained from major firms in the livestock, food processing and electronics sectors are utilized to generate expected growth rates for these three sectors. In addition, projections of future expenditure levels for city, county, state and federal government entities within the region were provided by the Larimer-Weld Council of Governments' planning staff and are utilized to project growth of the government sector.

The estimated compound growth rates in five-year increments are shown in Table IV-1. Note that government activity is assumed to grow at a constant

TABLE IV-1: ESTIMATED FINAL DEMAND GROWTH RATES TO THE YEAR 2000.

T I M E P E R I O D

Sector	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000
Livestock	0.020	0.020	-0.020	-0.020	0.020
Food Processing	0.060	0.050	0.040	0.020	0.010
Electronics	0.170	0.063	0.021	0.021	0.014
Government	0.068	0.068	0.068	0.068	0.068

rate over the twenty-five year period, while both the food processing and electronics sectors are projected to grow at diminishing rates. The livestock sector is assumed to have a cyclic growth pattern of expansion and contraction. Of the four sectors, electronics obviously is the most dynamic.

Assuming the growth rates of Table IV-1 and no expansion of final demand for the remaining sectors, the projected total gross outputs for each sector and the total economy are shown in Table IV-2. These projections are calculated for both households exogenous and endogenous to the processing sector. With households exogenous, these projections assume a declining marginal propensity to consume with increasing income. That is, the ratio of savings to income rises with higher incomes. When households are treated as endogenous, then the inducement effect of additional household spending is considered by assuming a constant marginal propensity to consume. These two cases represent the polar extremes of what is most likely the actual reaction of households to rising incomes. That is, they represent a minimum and a maximum estimate.

Table IV-2 indicates, for example, that for households exogenous and if only growth in the four sectors identified is considered, then the total gross output of the region is projected to expand from $8,072.66 million in 1975, to $15,618.92 million in 2000. As can be seen from the rate of change of total gross output, the near doubling of the regional total gross output over the twenty-five year period is projected to occur with declining rates of growth.

Table IV-2 also indicates the distributional impacts of growth in the four sectors. Not only do the four sectors grow, but the remaining sectors of the economy are also anticipated to expand due to the interdependencies of the regional economy. For example, with households exogenous, the

TABLE IV-2: PROJECTED TOTAL GROSS OUTPUT BY SECTOR IN FIVE-YEAR INCREMENTS FOR FINAL DEMAND
GROWTH IN FOUR SECTORS: 1975-2000.

(Millions of Dollars)

Sector		1975	1980	1985	1990	1995	2000
Livestock	X *	477.64	620.39	776.55	922.73	1,006.95	1,060.27
	I **	477.64	622.73	781.30	930.03	1,017.45	1,074.86
Irrigated Agriculture	X	128.23	154.30	182.99	210.86	227.93	239.42
	I	128.23	154.96	184.33	212.90	230.87	243.51
Dryland Agriculture	X	17.48	19.91	22.82	26.12	29.37	33.13
	I	17.48	19.96	22.92	26.26	29.57	33.41
Food Processing	X	809.73	1,071.41	1,357.53	1,643.53	1,811.02	1,902.57
	I	809.73	1,074.05	1,362.88	1,651.75	1,822.83	1,918.98
Mining	X	36.21	37.18	38.21	39.33	40.60	42.16
	I	36.21	37.43	38.73	40.12	41.75	43.75
Electronics	X	406.56	860.14	1,161.43	1,292.91	1,441.11	1,557.09
	I	406.56	860.25	1,161.65	1,293.25	1,441.59	1,557.76
Paper	X	2.70	2.89	3.09	3.30	3.55	3.87
	I	2.70	2.90	3.10	3.32	3.58	3.91
Printing	X	10.70	12.34	13.66	14.66	15.86	17.22
	I	10.70	13.28	15.57	17.59	20.07	23.08
Chemicals and Petroleum	X	5.11	6.85	8.35	9.50	10.41	11.14
	I	5.11	6.88	8.41	9.59	10.54	11.33
Lumber	X	11.96	12.90	13.54	13.87	14.25	14.60
	I	11.96	12.97	13.70	14.11	14.60	15.08
Miscellaneous Manufacturing	X	18.65	19.87	20.95	21.83	22.48	22.94
	I	18.65	22.39	26.06	29.67	33.76	38.62
Utilities	X	177.42	211.43	241.03	265.51	292.68	323.10
	I	177.42	229.93	278.57	323.19	375.63	438.33
Services	X	223.81	236.08	249.38	263.00	275.94	290.29
	I	223.81	253.60	284.95	317.65	354.52	399.45
Trade	X	994.20	1,005.26	1,017.55	1,030.71	1,044.04	1,059.48
	I	994.20	1,085.75	1,180.89	1,281.67	1,404.94	1,560.85
Education	X	180.86	221.66	276.82	352.13	456.52	601.11
	I	180.86	236.10	306.13	397.16	521.28	691.08
Households	X	1,240.68	1,445.20	1,655.73	1,878.40	2,157.76	2,514.70
	I	1,240.68	1,474.87	1,715.94	1,970.91	2,290.79	2,699.52
Final Payments	X	3,330.72	3,988.56	4,574.23	5,054.99	5,497.28	5,925.83
	I	3,330.72	4,193.09	4,989.28	5,692.71	6,414.37	7,199.85
Total Gross Output	X	8,072.66	9,926.37	11,613.89	13,043.37	14,347.74	15,618.92
	I	8,072.66	10,301.13	12,374.41	14,211.89	16,028.14	17,953.36
Percent Change	X	-	22.96%	17.00%	12.31%	10.00%	8.86%
	I	-	27.60%	20.13%	14.85%	12.78%	12.01%
Total Government Expenditures	X	409.98	569.66	791.54	1,099.84	1,528.23	2,123.46
	I	409.98	569.66	791.54	1,099.84	1,528.23	2,123.46

*   Households Exogenous
** Households Endogenous

electronics sector is projected to grow by 383 percent from $406.56 million of output in 1975, to $1,557.09 million in 2000, and to surpass the dollar value of output from both the livestock and the trade sectors. Moreover, this growth would be accompanied by growth in other sectors, such as utilities with a projected twenty-five year growth of 182 percent from $177.42 million of output in 1975, to $323.10 million in 2000, and education with a 332 percent increase from $180.86 million in 1975, to $601.11 million in 2000.

Since the government is not a processing sector, growth in government expenditures are shown separately in Table IV-2. These expenditures are projected to grow more than fivefold from $409.98 million in 1975, to $2,123.46 million in 2000. Moreover, these expenditures directly stimulate growth in the processing sectors of the economy.

Finally, Table IV-2 shows projected earned income by households. With households exogenous (endogenous), payments to households are projected to more than double from $1,240.68 ($1,240.68) million in 1975, to $2,514.70 ($2,699.52) million in 2000.

Employment projections can also be derived from Table IV-2. If the employment coefficients of Table III-6 are applied to the projected dollar value of outputs, then employment levels by sector can be projected as shown in Table IV-3. For example, with households exogenous, the projected $1,092.84 million increase in the food processing sector is estimated by this procedure to expand food processing employment by 224 percent from 3,402 persons in 1975, to 7,610 persons in 2000.

In order to project total employment for the region, it is necessary to project employment in the final payments sector as well as the processing sectors. Growth of employment in the government sector is assumed to occur at the same rate as the growth of government expenditures--6.8 percent.

TABLE IV-3: PROJECTED EMPLOYMENT BY SECTOR IN FIVE-YEAR INCREMENTS FOR FINAL DEMAND GROWTH IN FOUR SECTORS: 1975-2000.

Sector		1975	1980	1985	1990	1995	2000
Livestock	X*	7,165	9,306	11,648	13,841	15,104	15,904
	I**	7,165	9,341	11,720	13,950	15,262	16,123
Irrigated Agriculture	X	7,950	9,567	11,345	13,073	14,132	14,844
	I	7,950	9,608	11,428	13,200	14,314	15,098
Dryland Agriculture	X	559	637	730	836	940	1,060
	I	559	639	733	840	946	1,069
Food Processing	X	3,402	4,286	5,430	6,574	7,244	7,610
	I	3,402	4,296	5,452	6,607	7,291	7,676
Mining	X	1,159	1,190	1,223	1,258	1,299	1,349
	I	1,159	1,198	1,239	1,284	1,336	1,400
Electronics	X	6,884	14,622	19,744	21,979	24,499	26,470
	I	6,884	14,624	19,748	21,985	24,507	26,482
Paper	X	133	142	151	162	174	190
	I	133	142	152	163	175	192
Printing	X	645	740	820	880	952	1,033
	I	645	797	934	1,055	1,204	1,385
Chemicals and Petroleum	X	100	137	167	190	208	223
	I	100	138	168	192	211	227
Lumber	X	431	464	487	499	513	526
	I	431	467	493	508	526	543
Miscellaneous Manufacturing	X	867	914	964	1,004	1,034	1,055
	I	867	1,030	1,199	1,365	1,553	1,776
Utilities	X	2,531	2,960	3,374	3,717	4,098	4,523
	I	2,531	3,219	3,900	4,525	5,259	6,137
Services	X	7,540	8,027	8,479	8,942	9,382	9,870
	I	7,540	8,622	9,688	10,800	12,054	13,581
Trade	X	14,243	14,074	14,246	14,430	14,616	14,833
	I	14,243	15,200	16,532	17,943	19,669	21,852
Education	X	17,905	21,944	27,405	34,861	45,195	59,510
	I	17,905	23,374	30,307	39,319	51,607	68,420
Households	X	124	144	166	188	216	251
	I	124	147	172	197	229	270
Government[1]	X	9,229	12,824	17,818	24,758	34,402	47,801
	I	9,229	12,824	17,818	24,758	34,402	47,801
Finance, Insurance, and [2] Real Estate	X	2,597	3,111	3,567	3,942	4,287	4,622
	I	2,597	3,269	3,890	4,439	5,006	5,619
Construction and Ordnance [2]	X	5,508	6,597	7,566	8,361	9,092	9,802
	I	5,508	6,934	8,251	9,305	10,494	11,779
Total	X	88,972	111,686	135,330	159,495	187,387	221,476
	I	88,972	115,689	143,824	172,435	206,045	247,430

[1] Assumes 6.8 percent growth rate.

[2] Assumes same growth rate as final payments.

*   Households Exogenous
**   Households Endogenous

Employment growth in the remaining final payments sectors of finance, insurance and real estate, and construction and ordnance is assumed to occur at the same rates of growth as final payments. That is, the percentage increase estimated for final payments in Table IV-2 are utilized to project employment in these sectors.

Total employment in the two-county region is projected to grow from 88,972 persons in 1975, to between 221,476 and 247,430 persons in 2000, depending whether or not households are excluded from the processing sector. That is, if the growth rates of Table IV-1 are assumed, then regional employment is projected to merely triple over the next twenty-five years. Furthermore, by the year 2000, the electronics sector is conservatively (i.e., with households exogenous) projected to represent 10.7 percent of all employment, livestock 6.4 percent, government 19.3 percent and food processing 3.1 percent. The largest share of employment is projected to be in education with 24.1 percent and the smallest share in chemicals and petroleum with less than 0.1 percent.

Sensitivity Analysis

The sensitivity of the basic growth projections is tested for: (1) errors in the final demand growth estimates of the four sectors, and (2) final demand growth in the remaining processing sectors. That is, the sensitivity analysis seeks to establish the variability of the growth projections for errors in the estimated growth rates and to growth in final demand for the other sectors.

Sensitivity to Growth Rates. The first part of the analysis seeks to identify how sensitive the basic projections are to errors in the estimated growth rates of the livestock, food processing, electronics and government sectors. The question posed is what is the effect on the projected levels

of economic activity of a plus or minus error of 10 or 20 percent in the four sector growth rates.

The results of this analysis are shown in Tables IV-4 and IV-5. These results are calculated for households exogenous, since no variation of sensitivity is expected by either the exclusion or inclusion of this sector. Each table indicates the interval of estimated total gross output by sector and in total when the initial growth conditions are allowed to vary by ±10 and 20 percent. For example, Table IV-4 shows that projected total gross output of the livestock sector varies by 17.5 percent in the year 2000, when the basic growth estimates are allowed to vary by ±10 percent. Furthermore, variability is greater for some sectors than others. For example, while a ±10 percent change in the basic growth rates causes projected total gross output of the livestock sector to vary by 17.5 percent in the year 2000, it causes electronics to vary by 29.5 percent, food processing to vary by 18.4 percent, and government to vary by 37.5 percent. Other sectors, such as mining and lumber are less affected. Similar relations exist for Table IV-5.

Both Tables IV-4 and IV-5 indicate that the variance of total gross output increases with time. That is, errors in the initial assumptions are amplified with time. For example, a ±10 percent error in the basic growth rates cause the projected total gross output in 1980 to vary by 4.7 percent, but in 2000 it varies by 17.85 percent. The magnitude of the variance is directly related to the size of the error so that the intervals for ±20 percent changes in the four basic growth rates are more than twice the size of the ±10 percent intervals. On the other hand, note that the sizes of the projection intervals are less than the error intervals examined. For example, a ±10 percent error of estimated growth (i.e., a 20 percent interval) yields projected total gross output intervals ranging from 4.7 percent in 1980, to 17.85 percent in 2000.

TABLE IV-4: PROJECTED TOTAL GROSS OUTPUT BY SECTOR IN FIVE-YEAR INCREMENTS FOR ±10 PERCENT ERROR IN FINAL DEMAND GROWTH ESTIMATES IN FOUR SECTORS: 1975-2000.

(Millions of Dollars)

Sector	1975	1980	1985	1990	1995	2000
Livestock	477.64	636.51	814.85	985.85	1,086.13	1,149.51
	477.64	604.61	739.98	863.64	933.61	978.03
Irrigated Agriculture	128.23	157.25	190.03	222.63	242.99	256.84
	128.23	151.42	176.28	199.85	214.01	223.46
Dryland Agriculture	17.48	20.19	23.52	27.41	31.36	36.07
	17.48	19.64	22.16	24.93	27.57	30.53
Food Processing	809.73	1,101.05	1,428.04	1,762.10	1,960.76	2,070.23
	809.73	1,042.44	1,290.26	1,532.59	1,672.33	1,748.11
Mining	36.21	37.30	38.49	39.81	41.37	43.34
	36.21	37.06	37.95	38.88	39.91	41.14
Electronics	406.56	922.41	1,282.83	1,443.30	1,626.28	1,771.17
	406.56	801.37	1,050.47	1,156.99	1,275.68	1,367.48
Paper	2.70	2.92	3.15	3.39	3.70	4.11
	2.70	2.87	3.04	3.21	3.42	3.67
Printing	10.70	12.55	14.12	15.31	16.78	18.50
	10.70	12.13	13.25	14.07	15.03	16.10
Chemicals and Petroleum	5.11	7.07	8.82	10.18	11.28	12.18
	5.11	6.64	7.92	8.88	9.62	10.20
Lumber	11.96	13.02	13.80	14.20	14.66	15.10
	11.96	12.78	13.31	13.58	13.89	14.16
Miscellaneous Manufacturing	18.65	20.02	21.28	22.31	23.10	23.66
	18.65	19.72	20.65	21.38	21.91	22.29
Utilities	177.42	215.82	250.49	279.66	312.89	351.15
	177.42	207.24	232.26	252.60	274.57	298.50
Services	223.81	237.53	252.84	268.92	284.64	302.59
	223.81	234.67	246.11	257.54	268.07	279.42
Trade	994.20	1,006.57	1,020.71	1,036.25	1,052.48	1,071.87
	994.20	1,004.00	1,014.56	1,025.59	1,036.43	1,048.60
Education	180.86	226.39	289.95	379.43	507.46	690.50
	180.86	217.05	264.44	327.15	411.37	524.36
Households	1,240.68	1,470.69	1,715.47	1,980.32	2,322.54	2,773.30
	1,240.68	1,420.73	1,599.98	1,785.24	2,010.87	2,290.50
Final Payments	3,330.72	4,071.77	4,754.47	5,324.31	5,862.24	6,397.07
	3,330.72	3,908.90	4,406.27	4,807.75	5,167.61	5,507.47
Total Gross Output	8,072.66	10,159.06	12,122.86	13,815.39	15,400.68	16,987.19
	8,072.66	9,703.28	11,138.87	12,333.85	13,395.90	14,404.03
Percent Change	-	25.80%	19.33%	13.96%	11.47%	10.30%
	-	20.20%	14.79%	10.73%	8.61%	7.52%
Average Change	-	5.16%	3.87%	2.79%	2.29%	2.06%
	-	4.04%	2.96%	2.16%	1.72%	1.50%
Variance of Estimates	-	4.70%	8.83%	12.01%	14.96%	17.85%
Total Government Expenditures	409.98	588.03	843.41	1,240.68	1,735.07	2,488.59
	409.98	551.76	742.57	999.36	1,344.95	1,810.06

TABLE IV-5: PROJECTED TOTAL GROSS OUTPUT BY SECTOR IN FIVE-YEAR INCREMENTS FOR ±20 PERCENT ERROR IN FINAL DEMAND GROWTH ESTIMATES IN FOUR SECTORS: 1975-2000.

(Millions of Dollars)

Sector	1975	1980	1985	1990	1995	2000
Livestock	477.64	653.00	854.94	1,053.27	1,171.61	1,246.34
	477.64	589.19	705.06	808.34	865.73	902.29
Irrigated Agriculture	128.23	160.27	197.41	235.22	259.28	275.85
	128.23	148.60	169.87	189.55	201.16	208.83
Dryland Agriculture	17.48	20.47	24.26	28.81	33.56	39.42
	17.48	19.38	21.52	23.82	25.94	28.25
Food Processing	809.73	1,131.36	1,501.90	1,888.78	2,122.40	2,252.15
	809.73	1,014.12	1,226.08	1,428.82	1,543.93	1,605.86
Mining	36.21	37.42	38.79	40.34	42.23	44.69
	36.21	36.95	37.70	38.47	39.30	40.24
Electronics	406.56	988.34	1,415.50	1,609.52	1,833.32	2,012.62
	406.56	745.95	949.14	1,034.29	1,128.05	1,199.73
Paper	2.70	2.94	3.21	3.50	3.88	4.38
	2.70	2.85	2.99	3.13	3.29	3.49
Printing	10.70	12.78	14.61	16.03	17.82	19.96
	10.70	11.94	12.86	13.53	14.30	15.13
Chemicals and Petroleum	5.11	7.30	9.33	10.92	12.24	13.34
	5.11	6.44	7.51	8.30	8.90	9.36
Lumber	11.96	13.16	14.07	14.55	15.12	15.66
	11.96	12.66	13.10	13.32	13.56	13.77
Miscellaneous Manufacturing	18.65	20.18	21.63	22.84	23.77	24.47
	18.65	19.58	20.36	20.97	21.40	21.70
Utilities	177.42	220.42	260.68	295.14	335.44	383.12
	177.42	203.25	224.13	240.81	258.35	276.94
Services	223.81	239.02	256.51	275.31	294.25	316.53
	223.81	233.31	243.03	252.49	260.96	269.82
Trade	994.20	1,007.91	1,024.06	1,042.26	1,061.84	1,085.97
	994.20	1,002.77	1,011.74	1,020.86	1,029.56	1,039.04
Education	180.86	231.26	303.87	409.28	564.91	794.51
	180.86	212.56	252.77	304.33	371.39	458.52
Households	1,240.68	1,497.23	1,779.46	2,091.77	2,507.28	3,071.40
	1,240.68	1,397.24	1,547.96	1,700.14	1,880.01	2,096.22
Final Payments	3,330.72	4,158.65	4,947.86	5,617.54	6,266.10	6,927.91
	3,330.72	3,832.65	4,249.82	4,580.87	4,869.91	5,136.07
Total Gross Output	8,072.66	10,401.71	12,668.09	14,655.07	16,565.04	18,528.33
	8,072.66	9,489.44	10,695.63	11,682.03	12,535.73	13,325.26
Percent Change	-	28.85%	21.79%	15.68%	13.03%	11.85%
	-	17.55%	12.71%	9.22%	7.31%	6.30%
Average Change	-	5.77%	4.36%	3.14%	2.61%	2.37%
	-	3.51%	2.54%	1.84%	1.46%	1.26%
Variance of Estimates	-	9.61%	18.44%	25.45%	32.14%	39.05%
Total Government Expenditures	409.98	606.87	898.32	1,329.73	1,968.32	2,913.60
	409.98	534.31	696.33	907.49	1,182.69	1,541.34

Sensitivity to Growth in Other Sectors. The basic projections assume only growth in the livestock, food processing, electronics and government sectors. The sensitivity of this assumption is tested by allowing final demand in the other processing sectors to grow by 4 percent per annum. Irrigated agriculture is not assumed to grow since constraints on land and water availability as well as increasing urbanization appear to preclude such growth.

The results of the analysis are shown in Table IV-6. The effects on the livestock, food processing, electronics and government sectors is nominal. With households exogenous, year 2000 estimates vary by only 4.8 percent for livestock, 3.8 percent for food processing, 0.06 percent for electronics and zero for government. Other sectors are more significantly affected, such as trade with a year 2000 projected total gross output difference of 68.4 percent and services with 50.2 percent. Moreover, the variance between the projected total gross outputs of Table IV-2 and Table IV-6 increases over time. That is, an error in the initial assumptions will cause increasing divergence of the projections from the actual case.

The consequences of allowing livestock, food processing, electronics and government to grow according to the rates in Table IV-1 and all other sectors except irrigated agriculture to increase by 4 percent per annum can also be viewed as a high estimate of future economic activity in the region. For that reason, it is valuable to calculate employment figures as well as total gross outputs. These employment projections are shown in Table IV-7.

Evaluation of Projections

As the preceding indicates, the input-output model is a valuable tool for assessing the impact of various economic changes. It provides a method of assessing both the direct and indirect effects of such changes as well as

TABLE IV-6: PROJECTED TOTAL GROSS OUTPUT BY SECTOR IN FIVE-YEAR INCREMENTS FOR FINAL DEMAND
GROWTH IN ALL SECTORS: 1975-2000.

(Millions of Dollars)

Sector		1975	1980	1985	1990	1995	2000
Livestock	X*	477.64	621.05	778.03	925.19	1,010.61	1,065.40
	I**	477.64	623.75	783.56	933.77	1,023.00	1,082.59
Irrigated Agriculture	X	128.23	154.47	183.36	211.47	228.84	240.70
	I	128.23	159.07	193.00	226.65	250.26	269.18
Dryland Agriculture	X	17.48	21.85	27.13	33.30	40.04	48.05
	I	17.48	21.90	27.23	33.46	40.28	48.38
Food Processing	X	809.73	1,072.35	1,359.62	1,647.01	1,816.20	1,909.81
	I	809.73	1,075.33	1,365.72	1,656.48	1,829.86	1,928.80
Mining	X	36.21	43.94	53.20	64.33	77.79	94.17
	I	36.21	44.23	53.79	65.24	79.10	95.99
Electronics	X	406.56	860.26	1,161.69	1,293.34	1,441.75	1,557.98
	I	406.56	860.38	1,161.94	1,293.73	1,442.31	1,558.76
Paper	X	2.70	3.20	3.76	4.41	5.21	6.20
	I	2.70	3.20	3.78	4.44	5.24	6.24
Printing	X	10.70	12.97	15.06	16.99	19.33	22.07
	I	10.70	14.02	17.23	20.35	24.18	28.81
Chemicals and Petroleum	X	5.11	6.94	8.55	9.83	10.90	11.83
	I	5.11	7.07	8.83	10.27	11.52	12.66
Lumber	X	11.96	13.83	15.62	17.34	19.41	21.81
	I	11.96	13.92	15.80	17.62	19.81	22.37
Miscellaneous Manufacturing	X	18.65	20.47	22.28	24.04	25.76	27.54
	I	18.65	23.28	28.05	32.99	38.70	45.52
Utilities	X	177.42	215.82	250.76	281.75	316.82	356.87
	I	177.42	236.62	293.38	347.87	412.30	489.57
Services	X	223.81	255.02	291.36	333.01	380.05	435.88
	I	223.81	274.85	332.02	396.11	471.14	562.44
Trade	X	994.20	1,099.51	1,226.45	1,379.11	1,562.17	1,784.11
	I	994.20	1,190.05	1,412.01	1,667.02	1,977.85	2,361.87
Education	X	180.86	222.24	278.11	354.28	459.72	605.60
	I	180.86	238.41	311.24	405.68	533.94	708.78
Households	X	1,240.68	1,469.25	1,709.03	1,967.29	2,289.95	2,699.58
	I	1,240.68	1,502.79	1,777.77	2,073.96	2,443.94	2,913.56
Final Payments	X	3,330.72	4,068.71	4,751.90	5,351.31	5,937.96	6,542.13
	I	3,330.72	4,300.95	5,227.98	6,090.14	7,004.38	8,023.64
Total Gross Output	X	8,072.66	10,161.88	12,135.93	13,914.02	15,642.53	17,429.73
	I	8,072.66	10,589.83	13,013.33	15,275.78	17,607.80	20,159.58
Percent Change	X	-	25.88%	19.43%	14.65%	12.42%	11.42%
	I	-	31.18%	22.88%	17.38%	15.27%	14.49%
Variance from Base Projection	X	-	2.37%	4.49%	6.68%	9.02%	11.59%
	I	-	2.80%	5.16%	7.51%	9.86%	12.29%
Total Government Expenditures	X	409.98	569.66	791.54	1,099.84	1,528.23	2,123.46
	I	409.98	569.66	791.54	1,099.84	1,528.23	2,123.46

*   Households Exogenous
** Households Endogenous

TABLE IV-7: PROJECTED EMPLOYMENT BY SECTOR IN FIVE-YEAR INCREMENTS FOR FINAL DEMAND GROWTH IN ALL SECTORS: 1975-2000.

Sector		1975	1980	1985	1990	1995	2000
Livestock	X*	7,165	9,316	11,670	13,878	15,159	15,981
	I**	7,165	9,356	11,753	14,006	15,345	16,239
Irrigated Agriculture	X	7,950	9,577	11,368	13,111	14,188	14,923
	I	7,950	9,862	11,966	14,052	15,516	16,689
Dryland Agriculture	X	559	699	868	1,066	1,281	1,538
	I	559	701	871	1,071	1,289	1,548
Food Processing	X	3,402	4,289	5,438	6,588	7,265	7,639
	I	3,402	4,301	5,463	6,626	7,319	7,715
Mining	X	1,159	1,406	1,702	2,058	2,489	3,013
	I	1,159	1,415	1,721	2,088	2,531	3,072
Electronics	X	6,884	14,624	19,749	21,987	24,510	26,486
	I	6,884	14,626	19,753	21,993	24,519	27,499
Paper	X	133	157	184	216	255	304
	I	133	157	185	218	257	306
Printing	X	645	778	904	1,019	1,160	1,324
	I	645	841	1,034	1,221	1,451	1,729
Chemicals and Petroleum	X	100	139	171	197	218	237
	I	100	141	177	205	230	253
Lumber	X	431	498	562	624	699	785
	I	431	501	569	634	713	805
Miscellaneous Manufacturing	X	867	942	1,025	1,106	1,185	1,267
	I	867	1,071	1,290	1,518	1,780	2,094
Utilities	X	2,531	3,021	3,511	3,944	4,435	4,996
	I	2,531	3,313	4,107	4,870	5,772	6,854
Services	X	7,540	8,671	9,906	11,322	12,922	14,812
	I	7,540	9,345	11,289	13,468	16,019	19,123
Trade	X	14,243	15,393	17,170	19,308	21,870	24,978
	I	14,243	16,601	19,768	23,338	27,689	33,066
Education	X	17,905	22,002	27,533	35,074	45,512	59,954
	I	17,905	23,602	30,813	40,162	52,860	70,169
Households	X	124	147	171	197	229	270
	I	124	150	178	207	244	291
Government[1]	X	9,229	12,824	17,818	24,758	34,402	47,801
	I	9,229	12,824	17,818	24,758	34,402	47,801
Finance, Insurance, and Real Estate[2]	X	2,597	3,172	3,704	4,171	4,628	5,099
	I	2,597	3,354	4,076	4,748	5,461	6,256
Construction and Ordnance[2]	X	5,508	6,728	7,858	8,849	9,819	10,818
	I	5,508	7,112	8,645	10,071	11,582	13,268
Total	X	88,972	114,383	141,312	169,473	202,226	242,225
	I	88,972	119,273	151,476	185,254	224,979	273,777

[1] Assumes 6.8 percent growth rate.

[2] Assumes same growth rate as final payments.

* Households Exogenous
** Households Endogenous

both the total and distributional consequences.

In particular, the preceding discussion has illustrated the use of the model for projecting future economic conditions given certain assumptions. If one is confident with these assumptions, then such projections can be utilized as forecasts for planning purposes.

The question now is can the projections of the preceding growth scenario be utilized as foecasts of future production and employment. This decision depends essentially upon the judgment of the planner as to the acceptable level of uncertainty. The level of uncertainty associated with the scenario projections can be considered in terms of: (1) the basic assumptions of the model, (2) errors of measurement, and (3) unanticipated exogenous events.

The scenario projections are based on the assumptions that the mix of inputs in the production process and the labor input/production output ratio over time remain constant. Both of these relationships may change with time and the longer the time period the greater the probability of such a change.

The sensitivity analysis indicates that errors of measurement of the sector growth rates causes a divergence of projected values. The initial projection differences, however, appear reasonably small while projecting associated with more distant time periods have much larger differences.

Finally, the model itself cannot account for unanticipated exogenous events, such as the location of new industries in the region. Again, the likelihood of such events and, consequently, the introduction of error into the projections of the model increases with time.

Therefore, it would appear reasonable to utilize the growth scenario projections for planning purposes, recognizing that the greatest reliability should be attached to the near future projections. Furthermore, the prudent planner will allow for a periodic update of these projections and, thus, his plans in order to avoid gross planning errors.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This study provides three major products: (1) a descriptive analysis of the structure of the Larimer-Weld regional economy, (2) projections of economic growth, and (3) a tool for the continued analysis of the impacts of alternative futures on the regional economy.

Descriptive Model

The input-output model provides a description of the interdependent structure of the Larimer-Weld regional economy. It accounts for the total input and output of each sector of the economy, calculates the distribution of input requirements and output of each sector among all other sectors, and measures the effects of changes in demand for the products of each sector.

Highlights of the input-output analysis are shown in Table V-1. For example, this table indicates that the total value of sales by the livestock sector in 1974 was estimated at $477.64 million and that earned household income (i.e., payments to labor) from this sector totaled $35.94 million. Furthermore, the direct plus indirect plus induced effect on the entire economy of a dollar change in final demand for the livestock sector is $1.67, while the total change in household income of this dollar change is $0.14. If the final demand for output of the livestock sector should increase by $1,000; the total employment effect in the region would be an additional .03 jobs.

TABLE V-1:   SUMMARY OF INPUT-OUTPUT ANALYSIS, 1974.

Sector	Value of Output ($1,000,000)	Household Income by Source ($1,000,000)	[1] Direct Plus Indirect Plus Induced Business Multiplier	[2] Direct Plus Indirect Plus Induced Employment Multiplier	[3] Direct Plus Indirect Plus Induced Income Multiplier
Livestock	477.64	35.94	1.673	.0308	0.136
Irr. Ag.	128.23	5.41	1.487	.0721	0.103
Dryland Ag.	17.48	0.94	1.686	.0453	0.147
Food Proc.	809.73	33.78	1.944	.0222	0.120
Mining	36.21	13.22	2.370	.0537	0.579
Electronics	406.56	75.24	1.452	.0226	0.313
Paper	2.70	0.80	1.801	.0588	0.369
Printing	10.70	4.86	1.908	.0698	0.534
Chem. & Petro.	5.11	0.56	1.323	.0243	0.149
Lumber	11.96	3.50	2.013	.0522	0.433
Misc. Mfg.	18.65	5.58	1.733	.0555	0.378
Utilities	177.42	24.75	1.332	.0171	0.171
Services	223.81	69.30	1.783	.0443	0.395
Trade	994.20	144.55	1.621	.0230	0.224
Education	180.86	103.91	2.154	.1115	0.675

[1] In dollars of business activity per dollar of output delivered to final demand.

[2] In numbers of workers per $1,000 of output delivered to final demand.

[3] In dollars of income generated per dollar of output delivered to final demand.

Economic Growth Projections

The economic growth scenarios demonstrate the flexibility of the input-output model for planning purposes as well as provide projections of economic growth. Depending upon the level of confidence in the initial assumptions of these scenarios, the projections may represent reliable forecasts of future conditions.

Results of the economic growth scenarios are summarized in Table V-2. Total gross output and total employment projections are shown for four basic scenarios. The four sector growth scenarios assume only growth in the livestock, food processing, electronics, and government sectors. These growth rates were derived by direct interviews with representatives of these sectors. The growth in all sector scenarios allow the livestock, food processing, electronics, and government sectors to expand at the rates determined as well as a 4 percent per annum growth rate in all other sectors except irrigated agriculture. The household sector is both excluded and included from the processing sector in separate scenarios in order to allow for assumptions of increasing levels of savings with increasing income and constant savings levels with increasing income, respectively.

The results of a sensitivity analysis of these projections indicates that their reliability is greatest for the nearer time periods. If these projections are indeed to be utilized as forecasts of the future, then the prudent planner will allow enough flexibility in his plans to accommodate revisions of these projections in the future.

Further Use of Model

The results of this study only scratch the surface of the possibilities of the input-output model. The initial construction of the model represents a sizable investment of time and money, but the returns on this investment can be immense.

TABLE V-2:   SUMMARY OF ECONOMIC GROWTH SCENARIOS, 1975-2000.

	1975	1980	1985	1990	1995	2000
Total Gross Output ($1,000,000)						
Four Sector Growth-- Households Exogenous	8,072.66	9,926.37	11,613.89	13,043.37	14,347.74	15,618.92
Four Sector Growth-- Households Endogenous	8,072.66	10,301.13	12,374.41	14,211.89	16,028.14	17,953.36
Growth in All Sectors-- Households Exogenous	8,072.66	10,161.88	12,135.93	13,914.02	15,642.53	17,429.73
Growth in All Sectors-- Households Endogenous	8,072.66	10,589.83	13,013.33	15,275.78	17,607.80	20,159.58
Total Employment (number of persons)						
Four Sector Growth-- Households Exogenous	88,972	111,686	135,330	159,495	187,495	221,476
Four Sector Growth-- Households Endogenous	88,972	115,869	143,824	172,435	206,045	247,430
Growth in All Sectors-- Households Exogenous	88,972	114,383	141,312	169,473	202,226	242,225
Growth in All Sectors-- Households Endogenous	88,972	119,273	151,476	185,254	224,979	273,777

The growth scenarios have illustrated the utility of the model for constructing economic forecasts. The model can also be utilized to anticipate the immediate effects of alternative adjustments to the present economic structure. Such impact analyses can be used not only to assess the dollar benefits and costs of alternative plans, but also their political and social desirability in light of the economic effects. A catalog of possible uses of the model would be practically infinite, but obviously would include assessing the impacts of proposed 208 planning policies, the consequences of the Big Thompson flood with the subsequent infusion of relief and rehabilitation money, the effects of the urbanization of agricultural land and of land use policies to deal with this situation, and the role of government in the local economy.

The use of the model is limited by the availability of data and the necessitity of translating the initial conditions and changes into economic terms. With adequate resources, these limitations become less severe. Perhaps the most important limitation to the use of the input-output model is the imagination of the user.