THE SURVEY-BASED INPUT-OUTPUT MODEL AS A RESOURCE PLANNING TOOL

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TABLE OF CONTENTS

I. Introduction

Economists and regional scientists generally agree that the inter-industry or input-output model provides the most effective means to describe and analyze a region's economy. Use of the I-O technique in the U.S. was pioneered by Nobel prize recipient Wassily Leontief. The input-output technique is unique in that it simultaneously accounts for all components of the regional economy so that growth in each sector is consistent with that in all other sectors. Construction of an I-O model is a practical investment since it can be applied to the analysis of almost every facet of the regional economy and thus a new model need not be developed each time a new phenomenon is to be studied. Input-output models are more flexible and versatile than is commonly recognized. Although a linear model may seem overly simplistic, in fact, the limits of its application are set mainly by the inventiveness of the researcher and the availability of data. Computerization of the input-output model allows analysts to study alternative scenarios quickly in response to fast-changing resource development. However, the economic base model is an often-used alternative. Its main advantage is that it is inexpensive to construct. Therefore, this exposition begins with a discussion of both the economic base model and the input-output technique and also contains a discussion of the advantages of the input-output method over the economic base model. The discussion concludes with a justification for the use of primary survey-based data rather than secondary information sources in constructing the model.

I. THE ECONOMIC BASE MODEL

A. A Primitive Base Model

The economic base model is similar in concept to the well-known Keynesian model which is the basis for national income policy analysis.

Generally, however, data which are appropriate to construct income accounts for regions are not available. The base model thus is a very simplified Keynesian model. Usually proxy data such as employment are used to construct a ratio of total economic activity to "basic" economic activity for a region. It can be shown that this ratio roughly approximates the economic multiplier known as an export multiplier in the Keynesian model. The advantage of the base model is its extreme ease of construction and low cost. Charles Tiebout, The Community Income Multiplier: A Case Study, shows the relationship between the base ratio and a simple Keynesian multiplier. He divides total economic activity into sales which are endogenously determined (service or non-basic sales) and sales which are exogenously determined (exports), or basic sales. Thus, $Y_t = Y_b + Y_{nb}$ where Y_b is determined by consumers outside the region and service activity is proportionately related to the region's total sales, $Y_{nb} = \emptyset Y_t$. Substitution of these two equations results in $Y_t = \frac{1}{1-\emptyset} Y_b$, where $\emptyset$ is the propensity to spend income earned in the region on local purchases. For each added dollar of exports, $\frac{1}{1-\emptyset}$ dollars worth of added economic activity will occur in the region. The multiplier, $\frac{1}{1-\emptyset}$, is simply Y_t/Y_b which is often approximated by the ratio of total employment divided by employment in export industries in the region (however defined).

The preceding discussion illustrates the essential principle of the basic-non-basic dichotomy so essential to all multiplier analysis. Now a model of the economic base will be discussed which extends this simple concept.

Suppose that a community's economy has been divided into three sectors: exports, local investment, and local consumption. The unit of measurement is income accruing to residents. Thus, income accrues to local families from the three sectors mentioned.

Examples of such income would include: (export) wages and salaries paid by a manufacturer whose market is nationwide, wages and salaries paid by a restaurant or lodging place which sells to tourists, income received from the rent of housing to non-residents; (local investment) profit income of a local contractor, wages and salaries paid by a local construction firm; and (local service) income to a local barber or the income of a school teacher. The ties among these sectors, as the examples indicate, may be direct or only indirect.

In the short run, the level of demand created not only in the export, but also in the local investment sector, depends largely on forces other than the level of local income. Exports, for example, depend on external market supply and demand. The community is such a small part of this total market that it does not affect this market but is affected by it. Year-to-year variations in local investment are also assumed to depend on outside forces: business expectations, general credit conditions, decisions by firms and government agencies whose territory includes the study region, and other such non-local factors. All of this means that, for short-run analysis, export and local investment income are taken as given, that is, they are measured but not predicted by a base study. This leaves the local services sector which is "explained."

The local income and employment derived from the services sector depends partly upon local spending out of the income originating in the other sectors, just as non-basic employment was said to depend upon basic employment. In this sense, local service income is explained, e.g. predicted by the model. The nature of this explanatory dependency is important and needs examination.

B. The Local Services Sector.

Income from local services is derived via a two-step process: (1) residents spend some of their income on local products and services; and (2) part of these sales dollars remain within the local economy and become local income. (Goods and services, such as insurance, may consist mainly of imports which contribute little to local employment and income.)

Residents Spending on Local Consumption. Suppose that residents spend 50 percent of their income locally on goods and services. (Some of these goods and services may be produced locally like haircuts, while others are produced outside of town such as most items on a retailer's shelf.) This can be called a propensity to consume locally with a value of .5. The other 50 percent of their income is saved, spent outside the community, and paid out for taxes. Suppose dividend income (a type of export income) goes up one dollar. This does not mean that from this extra dollar of local income an additional 50 cents of income will be created through local spending.

Not all of the 50 cents out of a dollar that is spent locally is local income. Part of this 50 cents is paid out to bring in merchandise from outside the community (pay for imports), some may go as wages to nonresidents, and to other such nonlocal sources. Yet, part will accrue as local income in the form of wages and salaries, profits, rents, and other such sources of local income. Suppose that 40 percent remains as local income. If trade patterns and technology remain fixed, .4 will predict the "income propensity of the local sales dollar."

This added propensity, when combined with the first, shows the relation between income from exports, spending on local services, and the local income derived therefrom. Out of every dollar of local income 50 cents will be

spent locally on consumer goods and services and 40 percent of this 50 cents, or 20 cents, remains as the first round increase of income.

C. The Multiplier Process

The added 20 cents of income through local consumption spending is not the total expansion of income. The "multiplier" process has not been completed.

So far, local incomes have risen--over and above the assumed one dollar increase--by an additional 20 cents. Part of this 20 cents will be spent locally by consumers; in fact, one-half or 10 cents will be spent. Again, 40 percent of these sales dollars will remain as local income, 4 cents. But now local income is up by 4 cents and 50 percent of this will be respent locally and on and on. The cumulation of these rounds of induced spending may be expressed as a multiplier ratio.

The formula is:

$$\text{(2-1.)}\quad \text{Total Income Increase} = \text{Increase in (Export and/or Local Investment Income)} \times \frac{1}{1 - (\text{propensity to purchase locally} \times \text{income created per dollar of local service sales})}$$

The first term on the right-hand side is the $1.00 from increased exports. That combined with the two propensities yields:

$$\text{(2-2.)}\quad \text{Total Income Increase} = \$1.00 \times \frac{1}{1 - (.5 \times .4)} = \$1.00 \times \frac{1}{1 - .2} = \$1.25$$

The multiplier value is 1.25. The original income change of $1.00 has been increased to $1.25 through the feedback effect of the local consumption sector.

The more traditional base approach will yield the same result. Suppose that before any changes took place, local income amounted to $125 million of which $100 million was basic and $25 million was non-basic. Now the base analyst is asked to measure the total income impact per $1.00 increase in basic income.

A somewhat more sophisticated version of Tiebout's multiplier is:

$$\text{(2-3.)}\quad \text{Total Income Increase} = \text{Increase in Basic Income} \times \frac{1}{1 - \frac{\text{Non-basic Income}}{\text{Total Income}}}$$

Substituting the assumed values:

$$\text{(2-4.)}\quad \text{Total Income Increase} = \$1.00 \times \frac{1}{1 - \frac{\$25 \text{ million}}{\$125 \text{ million}}} = \$1.00 \times \frac{1}{1 - .2} = \$1.25$$

This result is identical to that found using Tiebout's total to base income ratio.[1] The advantage of this version is that it points up the two propensities involved, the propensity to consume locally (.5), and the propensity of a sales dollar to become local income (.4). In discussing below such concepts as the stability of the total/basic ratio , this is important.

D. The Multiplier Including Local Consumption and Local Investment

Suppose the propensity to invest in new plant and equipment amounts to 20 percent of income. Again, it must be remembered that not all of this local spending remains within the community. Some is paid out for imports of items needed for investment goods. Suppose this amounts to one-half. Thus, the propensity to invest locally is .2 and the local income created per dollar of investment sales is .5. These values can now be introduced along with the consumption propensities. The multiplier reads:

$$\text{(2-5.)}\quad \text{Total Income Increase} = \text{Increase in Export Income} \times \frac{1}{1 - [(\text{propensity to spend locally} \times \text{income created per dollar of local services sales}) + (\text{propensity to invest locally} \times \text{income created per dollar of local investment sales})]}$$

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[1] This is equivalent to Tiebout's multiplier which is found by the ratio of total income to basic income. Equation 3 above can be restated as, $\Delta Y_t = \Delta Y_b \times \frac{1}{\frac{Y_t - Y_{nb}}{Y_t}}$ where the right-hand term is $\frac{1}{\frac{Y_b}{Y_t}} = \frac{Y_t}{Y_b}$ (since $Y_t = Y_{nb} + Y_b$).

Substituting values assumed:

(2-6.) Total Income Increase = $1.00 x $\frac{1}{1 - [(.5 \times .4) + (.2 \times .5)]}$

= $1.43

The multiplier value is 1.43. It is higher than the consumption-only multiplier, given in (2-2.), since both sectors produce added local income.

If the forecasted increase of income earned in the export sector is $100 million at the end of the decade, income created in the local investment and consumption sectors will be up $43 million. In this sense, the model is useful in forecasting since only the change in exports need be given.

E. A Further Closing of the Model

In the long run, more propensities are introduced.[2] The appropriate equation given in the three sector model takes the form:

(2-7.) Total Income Increase = Increase in Export Income x

$$\frac{1}{1 - ((\text{propensity to spend locally} \times \text{income created per dollar of local service sales}) + (\text{propensity to invest in local business} \times \text{income created per dollar of local business investment sales}) + (\text{propensity to invest in local housing} \times \text{income created per dollar of local housing sales}) + (\text{propensity to invest in local government} \times \text{income created per dollar of local government investment}) + (\text{propensity to spend on current account for local government} \times \text{income created per dollar of local government current operations spending}))}$$

Since this may appear unwieldy when written out, a numerical example will be helpful. Assume Table 2-1 values.

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[2]It is implied that some sectors react with a lag or base their activity on "permanent" rather than transitory changes. In the long run, these sectors become endogenous rather than exogenous to the model. The degree to which the model is "closed" by a researcher depends partly upon the time span of the forecast.

Table 2-1. Hypothetical Propensities and Income Per Dollar of Sales.

	Propensity to Spend	Income Created per Dollar of Local Sales
Consumption	.5	.4
Business Investment	.08	.1
Housing Investment	.15	.3
Local Government Investment	.05	.2
Local Government Current Operations	.1	.7

With a one dollar increase in Exports (including sales to federal government), the equation would read:

(2-8.) Total Income Increase =

$$\$1.00 \times \frac{1}{1 - [(.5 \times .4) + (.08 \times .1) + (.15 \times .3) + (.05 \times .2) + (.1 \times .7)]} = \$1.49$$

The multiplier value is 1.49 in this example. The multiplier is larger than previous examples simply because more sectors have been made endogenous to the model, i.e., more local sectors react to change in export income. Clearly the size of the multiplier depends upon ones definition of "basic" industry. The view of base analysis presented here is that basic industries are those whose level of activity is not dependent upon the level of economic activity in the local community. In the short run, other sectors besides exports can be considered as basic; local housing investment is an example of one such sector. Over the longer time span only the export sectors and certain exogenously-determined components of federal purchases should be considered basic.

F. Forecasting Basic Sales

A formula which forecasts the level of the export sector would complete the model. Indeed, to many base analysts this is the number one question. Unfortunately, a pratical discussion of the techniques and problems associated with export forecasts must be left to a future report.

G. The Local Services Sector: Some Problems

In the professional journals debates over economic base analysis have covered a wide range of points. Before adding other sectors, the simple model with only three sectors--exports, local investment, and local consumption--provides a sufficient framework to discuss many of the points raised. The most common debate target is the local services (non-basic) sector. In effect, the debates center over the stability of the $\frac{\text{total income}}{\text{base income}}$ ratio--whether the ratio is measured in income, employment, or some other unit.

It is useful to recall the two components determining local services (non-basic) income: the propensity to spend locally and the propensity of a dollar of sales to become local income. The multiplier may vary over time because either consumers' propensities to spend locally out of income are unstable or because local income created per dollar of local services sales is unstable. This argument follows from the local consumption multiplier discussed above. Over time the value of the multiplier determines the porportion of local services income to total income. And the multiplier depends upon the value of these two propensities. So the simple thing to do is examine each propensity in a given study region, and see what reasons might suggest stability or instability.

A crucial factor in the analysis is how non-basic spending is related to local income. The model assumes proportionality but this may be incorrect. Suppose income doubled. Is everybody in the community twice as rich or does everybody have the same income, but there are twice as many people? In either case, community income will double, but local consumption spending patterns might be different. The most usual case is a combination of both types of income change, and it is necessary to understand this difference.

If the income grows because of population growth, what does this imply for local consumption income? First of all, the new residents are likely

to have the same spending patterns on consumer goods and services--granting an impact on housing investment discussed below. This implies a need for more food stores, barbershops, dentists, and other such local consumer activities. The most reasonable expectation is that these will increase proportionately with the population-income movement.

Above and beyond this, however, with more consumers a market develops for specialty items: a legitimate theater, a local baseball team, etc. Thus, consumers can now purchase locally items which previously had to be imported. Added impacts come at the indirect producer level. With more food stores in the community, a local bottling plant becomes profitable and soda pop need not be imported. Added local dentists make a local dental supply house feasible. The size of the market is now sufficient in terms of economies of scale to support these new activities. Both consumers and purchasers may tend to import less as the local economy develops.

The pure per capita income increase case is somewhat trickier. If people receive more income, their spending patterns will change. First of all, while they spend more in absolute terms, they are likely to spend less proportionately, taxes and savings taking a bigger portion of income. A second factor is that such spending as does take place may show a relative increase in imports as opposed to local spending. More well-to-do families are apt to spend more outside the community on such things as vacations and clothes-buying trips. These two factors would cause a decreasing propensity to spend locally.

Offsetting this tendency are the same factors listed in the population rise situation, new specialized stores, more firms indirectly tied to local consumption, and so on. In addition, higher income families are likely to spend more on services such as health, entertainment, and beauty parlors

which are not only local activities but create high income per sales dollar. Thus, the two tendencies offsetting each other pull us back towards proportionality. Which is more powerful is a subject of investigation. Only repeated empirical studies can determine more completely which phenomenon dominates.

The niceties of the above argument notwithstanding, one seeming fact dominates the discussion: some empirical studies show that the base ratio is unstable. One such study can serve to illustrate the issue. The Federal Reserve Bank of Kansas City looked into the behavior of basic and non-basic employment in Wichita, Kansas.[3] The relationship did not appear very stable.

H. Import Substitutions

As local income rises over time the presumption here is that more of the same goods and services are being produced locally and, for the reasons noted above, income from local consumption may rise more than proportionately as new unique stores and services are offered in the expanded market.

Economic base studies could be modified to take account of import substitution by observing time series data from developing communities. Of course, they do not account for import substitution which might occur because of technological changes, e.g., a new process makes local production less costly; changes in transport costs, e.g., it is now more profitable to assemble durable goods locally instead of importing the finished products; or other changes of this nature. Few economic frameworks can handle this kind of change. This does not mean they are ignored but simply that after a base model has been constructed these kinds of factors can be introduced in any forecasts of future community income.

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[3] "The Employment Multiplier in Wichita," Monthly Review, Federal Reserve Bank of Kansas City, XXXVII (September, 1952), pp. 1-7.

I. Instability of the Base Ratio

The final question is whether the base ratio varies from community to community? The answer is yes, but in a predictable manner. That is, the variations can be explained on the basis of a few factors. Finally, by again looking separately at the two components of the local consumption sector--the propensity of consumers to spend locally and the local income generated per dollar of sales--the forces affecting the ratio can be systematically analyzed.

Several factors affect the propensity of consumers to spend locally. A non-exhaustive list would include: community size, geographic isolation, and income. Consider a large community vis-a-vis a small town. In the larger community more items are available on which to spend income locally than in the small town; e.g., opera. Studies of consumer spending, while not conclusive, support this notion. Geographic isolation is a more apparent factor. Two communities may be similar in other respects, but if one is a suburb while the other is isolated, the suburb will have less local spending as more purchases are made in (imported from) the central city. Finally, higher income communities are likely to have a smaller percent of the income spent locally.

The income generated per dollar of consumer sales also varies with the size of the community and its geographic isolation. As communities grow in population, the volume of consumer oriented activity grows more than proportionately as mentioned above. The degree of isolation is an important factor. If nearby communities can provide the indirect consumer goods and services, the market will be shared and less dollars will accrue locally per dollar of consumer sales.

Thus, the larger and more isolated the community, the greater the local income generated per dollar of local sales. Since consumers' propensities to

spend locally vary in the same manner, the following general relation emerges: increased size and geographic isolation tend to raise the total income/basic income ratio or stated another way, the multiplier rises with city size and isolation.

J. The Limited Application of Base Models

The economic base technique has many limitations. Two deficiencies stand out. First, the base model only shows the multiplier effects of changes in aggregate exports, i.e., changes in sales outside the region by the basic sector. (A related problem concerns the definition of what is basic and is non-basic). In contrast, the input-output model clearly delineates each component in each industry which is basic (or part of final demand in I-O terminology). By disaggregating each industries purchases and sales, the I-O model allows much more accuracy in the estimation of multiplier effects.

A second deficiency in the base method is that it fails to achieve detailed consistancy in its forecasts. While the I-O model requires, through its structure, that the output from each industry is just sufficient to satisfy demand, no such requirement is imposed by the base model at the industry level. Consequently, while total income may be correctly identified by a base model, little can be said about its components. This limitation is very serious for practical applications. Predictions of aggregate output or income for a region are very seldom sufficient, nor are they very accurate. Since exports by all industries are aggregated to find the base model multiplier, predictions made with the simple base multiplier implicitly assume that all industries exports continue to rise in proportion to the initial export levels. Practical application of regional forecasting almost always requires the study of changes in particular export sectors and one also may wish to analyze changes in export mix, investment change or changes

in government purchases. The base model supplies only a very crude average estimate of the impact of such changes. The final and most telling weakness of the base method is that it fails to provide predictions of output change on an industry by industry basis. Conversely, the I-O method can supply predictions for each industry and for local government sectors as well. Only the I-O model has the ability to supply information useful to measure changes in local requirements and fiscal problems associated with economic change. In particular, the industry by industry forecasts provided by the I-O model allow forecasts of numerous other variables closely associated with each industries output, e.g., employment, energy use, pollution, population change, etc. Several other unresolved problems with the base method, both conceptual and empirical, are discussed in (23, 40, 41).

II. ADVANTAGES OF SURVEY-BASED INPUT-OUTPUT MODELS

From time to time, attempts are made to short cut the survey process which is required to develop the table of transactions for the input-output model. (See Chapter IV for an example of the typical survey data collection effort.) A number of comparisons have been made between the estimated coefficients and multipliers derived by various adjustment processes applied to national input-output models and multipliers found by direct survey based research. Generally, the comparison has been unfavorable to the non-survey techniques. Still, efforts continue to reduce the time and money costs by substituting computerized and standardized adjustments of national models in order to generate regional input-output models.

Recent attempts to do this are shown by (2, 9, 43) and also by unpublished Forest Service techniques which have been applied to RARE II and other impact assessments on a wide scale. Apparently no comparison has yet been published to demonstrate the acceptability of these recent non-survey based models. One fairly recent publication by the Water Resources Council (44) provides output multipliers for BEA economic areas. It is suggested in the WRC report that these multipliers be used if no other better estimates are available. Some comparisons of the multipliers generated by this study with survey based multipliers are shown (44, pp. 129-133). While the errors are reported to be lower than found in earlier work, very significant discrepancies exist between the non-survey and survey multipliers for certain sectors.

Earlier attempts to construct non-survey based I-O models met with much criticism. Schaffer and Chu, after testing several non-survey techniques, conclude that, "...there still is no acceptable substitute for a good survey-based study" (42). Czamanski and Malizia also constructed non-survey I-O models and compared them to survey based models (7). They conclude, "...that although national input-output models cannot be used for purposes of regional studies without considerable adjustments, acceptable results can be achieved by the methods tried on the Washington State table." In his comment (39) on the Czamanski-Malizia paper, Miernyk notes that, "To achieve an acceptable "I" value they eliminated six sectors from their table, but these represented twelve sectors in the State of Washington table. They also aggregated ten of the Washington tertiary sectors into

two in their model. In effect, this reduced the 54-sector Washington table to 34 sectors. If one wanted the detail given in the original Washington table, it would be necessary to conduct field surveys in 20 sectors..." Miernyk also notes that some of the combined sectors, such as electric energy, are very important analytically. He concludes, "If it is necessary to conduct surveys in sectors accounting for about 28 percent of a region's total gross output--and this would seem to follow from the author's analysis--why not identify the remaining key sectors in the region and expand the survey to cover them as well?"[4]

Our review of comparisons of survey and non-survey input-output models would seem to indicate that non-survey models should not be used for making long-range forecasts which might have important policy implications. The degree of error inherent even in survey-based models makes their application to very long-run projections suspect at best. Introducing added errors through non-survey techniques may make such models unusable.

At a time when increasing pressures are placed on agencies faced with the responsibility of managing resources, it is important both that the best possible information be available to justify decisions and also that those affected respect the quality of information which is used. Increasing sophistication on the part of industry groups and attempts by

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[4]It is unclear how one can identify apriori which sectors may be satisfactorily estimated from secondary data. Also, if it is desired to provide secular adjustment of technical coefficients to reflect technological advance, or change in the age of capital inputs, national models may be of little use.

states to gain more control over resources within their borders, require that managers be able to quantify the decision variables and to document their methodology and data sources in a credible manner. The use of national input-output models is unlikely to serve these purposes. This is not to say that the generation of non-survey multipliers is ruled out in all cases. The degree of importance and time allowed for the analysis must determine the effort expended to achieve acceptable results. In such cases, however, the considered judgement of local regional economists might suffice as well. Perhaps the worst danger from the proliferation of non-survey multipliers arises from their indiscriminate use by persons neither familiar with their limitations nor aware of the economic nature of the regions which they may be responsible for analyzing.

Our own experience with survey based input-output models leads us to conclude that, for our purposes, the kind of detail provided by non-survey models, is inadequate for local impact analysis. In particular, the numerous local service sectors, local government sectors, and sectors peculiar to a region often dominate the economy of a small study area. None of these sectors can be estimated by non-survey techniques. The few sectors which might be estimated from national models can usually be surveyed at little added cost.

III. A DESCRIPTION OF INPUT-OUTPUT MODELLING

A. Statement of the Problem

The natural resource base in a region, while relatively abundant in terms of the capability to satisfy local demands, is nonetheless the focal point for regional and extra-regional economic conflict. Ownership of large amounts of exploitable resources is vested largely with the federal government and corporations headquartered out of the region. Water use is

governed by state water law, interstate compacts, and international treaty. Thus, from a regional perspective, policies affecting the disposition of the regional resource base are largely determined outside of the region. From this same perspective, there is a need to develop a detailed description of the economy as it presently exists and an analytical framework which is capable of assessing the direct and indirect consequences of alternative scenarios for resource exploitation proposed by the public and private sectors of the economy.

B. The Model Used

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

The purpose of the interindustry input-output modelling technique is to provide a detailed description of a regional economy and to develop a means for projecting future economic conditions. The input-output approach utilizes the following base data:

1. An industry-by-industry sales and purchases distribution, measured in dollars.

2. A measurement of the extent to which each industry purchases labor, raw materials, and processed goods within the study region as opposed to imports from outside the region.

3. Employment on an industry-by-industry basis in the study region.

In addition to the information provided directly by the base data, the input-output model is used to: (1) generate provisional forecasts of future economic activity in each economic sector, and (2) estimate industry-by-industry output and employment in future years. These provisional forecasts may be based upon expectations for growth held by the key industrial sectors which have the greatest economic influence on the study region.

C. Nature of the Model

An input-output model empirically illustrates the interdependent economic structure of the study 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 intermediate 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 sectors. Thus, if it is known that sales to government, investment, or exports by any particular sector are 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 which mutually and simultaneously satisfy all requirements for intermediate and final production. Once the essentials of the model have been identified and the basic empirical description of economic transactions developed, forecasting with the analytical technique requires only the specification of appropriate changes in final demand.

The input-output methodology is simply to divide the industries of the regional economy into two groups: (1) businesses which service and supply inputs mainly to other businesses within the region, and (2) business firms which sell mainly to customers outside the region. The latter group of firms are often termed "basic" industries. "Basic" industries along with government, investment, and, if desired, households form the demands which determine the business activity of the local suppliers of raw materials, labor, and processed goods. The local economy is said to be "driven" by the growth of basic industry, government, investments, and other "final demands." Thus, in order to project local business activity, it is important to determine the key economic sectors. These driving sectors will be the businesses which sell most of their output outside the region but purchase a significant share of their inputs inside the region. In order to be of major importance, the businesses must also have a significant size and show expectations of volatility (high future growth or, possibly, high rates of decline).

In order to determine the nature of each industry in a region and to see whether the industry is one of the important driving sectors, a

transactions table is constructed. This transactions table is a system of double entry bookkeeping such that sales and purchases by each industry to and from each other industry (as well as labor, government, and exports) are accounted for and measured. A typical transactions table for regions in Wyoming (Albany, Carbon and Sweetwater Counties) is shown in Table 1. Each column of Table 1 shows the distribution of purchases made by the industry shown at the column head.

Two features of the input-output technique make it particularly desirable for the analysis of growth and development in a regional economy. First, the technique provides information on sales and related variables (such as employment and income) on an industry-by-industry basis. This information is much more useful than more generally aggregated data. Second, the projections of future business activity in the region are consistent. That is, the projected value of production by each sector is the minimum required to meet the needs of other industries in the region and projected exports. Inputs and outputs must be in accounting balance at all times. This simultaneous balancing of production to requirements among industries in the region provides much more realistic projections than isolated forecasts for individual industries.

D. Input-Output Projections

The input-output technique provides two forecasting tools: (1) multipliers and (2) development scenarios. A multiplier indicates how much business activity in dollars of transactions and/or in employment is generated within the region for each dollar of sales by a given industry to final demand. Final demand is defined as sales to federal and state government, investments, and exports outside of the region. A multiplier will be large for an industry which purchases a large part of its inputs

TABLE 1
TRI-COUNTY REGION IN SOUTHERN WYOMING - 1977

GROSS FLOWS TABLE (last rows show resource inputs)

		1	2	3	4	5	6	7	8	9	10
		AG/LIVESTK	COAL-MINES	MINES-NEC	OIL/GAS-PR	CONSTRUCT	ALL-MFG	TRANS/COMM	ELEC/GS-UT	WHOLESALE	RETAIL
1	AG/LIVESTK	11549528.	427887.	0.	0.	9027.	0.	0.	0.	0.	0.
2	COAL-MINES	0.	12360873.	0.	0.	0.	0.	0.	17101536.	0.	0.
3	MINES-NEC	0.	0.	4018314.	0.	3132166.	910323.	0.	105000.	0.	0.
4	OIL/GAS-PR	0.	0.	0.	10832209.	0.	9875974.	0.	16821861.	0.	0.
5	CONSTRUCT	9146.	1332158.	1822534.	781045.	33701341.	957435.	0.	807890.	494825.	549603.
6	ALL-MFG	1991074.	5022901.	3701855.	1910366.	9892009.	2214079.	4695651.	650209.	79011.	2133353.
7	TRANS/COMM	661194.	402043.	2710176.	2363986.	1717312.	2629716.	811073.	81043.	5176856.	7498485.
8	ELEC/GS-UT	1114168.	663131.	13393515.	5392951.	488689.	1655407.	1314347.	2663606.	382014.	2779990.
9	WHOLESALE	211285.	95574.	2546165.	1129274.	840734.	335983.	0.	67331.	37600.	75820.
10	RETAIL	6909882.	19498.	331006.	325570.	2538950.	292784.	84542.	15075.	270479.	378002.
11	FIN/INS/RE	18687707.	2850541.	0.	834861.	4249213.	1346888.	189030.	10825142.	1873134.	5491652.
12	SERVICES	2208089.	1700930.	146520.	1546938.	4134642.	718700.	613668.	58957.	1249505.	2288476.
13	MEDICAL	1458.	0.	399091.	977.	120830.	7140.	598515.	0.	2700.	0.
14	EDUCATION	0.	0.	0.	0.	226502.	9208.	0.	0.	2443.	0.
15	WATER/SAN	88100.	4279.	0.	30443.	181113.	10998.	504613.	10597.	18367.	178224.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	LOC-TAXES	2741322.	11050654.	10263983.	12555450.	1100017.	1742661.	4972270.	10350166.	896455.	1806360.
19	SUBTOTALS	46172953.	35930469.	39335159.	37704070.	62332545.	22707296.	13783709.	59558413.	10483389.	23179965.
20	HOUSEHOLDS	5761675.	41427309.	85680019.	11629293.	74969419.	16970774.	45158354.	11509661.	11898014.	43955566.
21	STATE-GOV	339848.	15583031.	5623399.	7548587.	1177753.	619532.	1901102.	288681.	550578.	797815.
22	FED-GOV	1405732.	31930619.	24524910.	19153525.	12078325.	4145843.	6682512.	2134297.	5289667.	9777057.
23	TRANSFERS	3145844.	479853.	0.	140532.	715302.	226732.	31820.	1822279.	315319.	924452.
24	PROFITS	3277162.	37440000.	70855077.	75776864.	12822912.	9705872.	8836026.	21796616.	14538595.	25729160.
25	DEPREC	14412119.	17924275.	42108302.	5053460.	13042545.	2746967.	7616396.	17753896.	1781933.	4150468.
26	IMP-WYOM	2654620.	17269070.	53703475.	19184344.	49560348.	33636121.	6892849.	681417.	930490.	2792858.
27	IMP-WORLD	17799698.	32137946.	71013060.	10510289.	48449669.	24402387.	9949573.	2718892.	5452093.	4002622.
28	TOTALS	94969651.	230122574.	392843404.	186700966.	275148820.	115161524.	100852341.	118264152.	51240078.	115309963.

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

TABLE 1 (continued)
TRI-COUNTY REGION IN SOUTHERN WYOMING - 1977

GROSS FLOWS TABLE (last rows show resource inputs)

		11 FIN/INS/RE	12 SERVICES	13 MEDICAL	14 EDUCATION	15 WATER/SAN	16 LOC-ROADS	17 LOC-GOV	18 LOC-TAXES	19 SUBTOTALS	20 HOUSEHOLDS
1	AG/LIVESTK	0.	0.	3126.	0.	0.	0.	0.	0.	11989568.	2240727.
2	COAL-MINES	0.	0.	0.	0.	0.	0.	0.	0.	29462409.	35731.
3	MINES-NEC	0.	0.	0.	0.	0.	0.	0.	0.	8165803.	353672.
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.	0.	0.	37530044.	0.
5	CONSTRUCT	117474.	940931.	5059.	2681911.	7689.	536400.	858698.	0.	45604139.	2383650.
6	ALL-MFG	635820.	556644.	460322.	91362.	3863.	0.	108154.	0.	34146673.	12959883.
7	TRANS/COMM	689864.	1927017.	390273.	2129867.	21458.	8800.	158503.	341399.	29719065.	16532935.
8	ELEC/GS-UT	269368.	1917564.	135615.	2906746.	184793.	25000.	311667.	0.	35598571.	14039671.
9	WHOLESALE	3763.	1061510.	87282.	344448.	0.	180346.	63252.	0.	7080367.	15926478.
10	RETAIL	223529.	897457.	196198.	81023.	106692.	146224.	241738.	0.	13058649.	75923109.
11	FIN/INS/RE	603302.	4317175.	1476629.	1954819.	2513618.	26533.	417831.	0.	57658075.	57258462.
12	SERVICES	2063671.	2551937.	622208.	2175326.	49440.	8000.	186900.	0.	22323907.	29250577.
13	MEDICAL	0.	0.	1921771.	19081.	0.	0.	561104.	7317723.	10950390.	28327639.
14	EDUCATION	0.	7518.	0.	45033.	0.	0.	0.	29836279.	30126983.	3834672.
15	WATER/SAN	24732.	421214.	34197.	186987.	0.	40000.	20320.	363214.	2117398.	3665709.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	4560795.	4560795.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	16127774.	16127774.	0.
18	LOC-TAXES	356749.	1139796.	525369.	0.	0.	0.	0.	0.	59503252.	8654053.
19	SUBTOTALS	4988272.	15738763.	5858049.	12616603.	2887553.	971303.	2928167.	58547184.	455723876.	271386972.
20	HOUSEHOLDS	10001604.	24422558.	12645512.	63407338.	1377501.	1443993.	7213971.	0.	469472568.	2040879.
21	STATE-GOV	252613.	262265.	3505.	1594231.	0.	0.	165884.	0.	36708824.	35175787.
22	FED-GOV	3177768.	3884481.	1044934.	1031281.	9120.	2000.	60031.	0.	126332102.	111462155.
23	TRANSFERS	69579354.	726743.	248572.	5645157.	423136.	4467.	747514.	0.	85177076.	9638757.
24	PROFITS	9206564.	11147691.	24677974.	15861977.	47781.	51000.	3245704.	7296856.	352313836.	22649515.
25	DEPREC	703526.	5187300.	962497.	0.	85542.	0.	0.	0.	133529226.	0.
26	IMP-WYOM	17361208.	5302445.	2445703.	8347802.	197392.	566012.	292658.	0.	221818818.	36652600.
27	IMP-WORLD	6925168.	12368520.	3214188.	8432082.	1019401.	1522020.	1473845.	0.	261391458.	156312700.
28	TOTALS	122196077.	79040766.	51100934.	116936471.	6047426.	4560795.	16127774.	65844040.	2142467792.	645319368.

1	EMPLOYMENT	0.1041E 04	0.3335E 04	0.1353E 04	0.4750E 04	0.1590E 03	0.1620E 03	0.9490E 03	0.	0.	0.
2	WITHDRAWAL	0.5988E 09	0.2766E 09	0.2606E 09	0.1754E 09	0.	0.	0.	0.	0.	0.
3	CONSUMP.	0.1466E 09	0.7114E 08	0.6643E 08	0.4477E 08	0.	0.	0.	0.	0.	0.

TABLE 1 (continued)
TRI-COUNTY REGION IN SOUTHERN WYOMING - 1977

GROSS FLOWS TABLE (last rows show resource inputs)

		21 STATE-GOV	22 FED-GOV	23 TRANSFERS	24 INVESTMENT	25 OIL-R+D	26 EXP-WYOM	27 EXP-WORLD	28 TOTALS
1	AG/LIVESTK	245.	0.	0.	0.	300000.	10279838.	70159273.	94969651.
2	COAL-MINES	0.	0.	0.	20299867.	0.	0.	180324566.	230122574.
3	MINES-NEC	0.	0.	0.	0.	1311.	0.	384322616.	392843404.
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.	149170922.	186700966.
5	CONSTRUCT	25545732.	21156811.	925907.	121481669.	58048910.	0.	0.	275148820.
6	ALL-MFG	666814.	8313.	0.	0.	454614.	3346261.	63578966.	115161524.
7	TRANS/COMM	189612.	800266.	0.	0.	2671112.	0.	50939351.	100852341.
8	ELEC/GS-UT	34513.	146494.	0.	0.	529459.	37734387.	30181057.	118264152.
9	WHOLESALE	65357.	131780.	0.	23598761.	1071447.	3365888.	0.	51240078.
10	RETAIL	254972.	104740.	252729.	16764094.	1142735.	4780397.	3028538.	115309963.
11	FIN/INS/RE	71322.	15899.	0.	0.	7192319.	0.	0.	122196077.
12	SERVICES	681483.	535572.	5116011.	5420034.	2185227.	0.	13527955.	79040766.
13	MEDICAL	334247.	156000.	10324244.	0.	8414.	0.	1000000.	51100934.
14	EDUCATION	51440014.	13795058.	0.	0.	0.	10926209.	6813535.	116936471.
15	WATER/SAN	2049.	0.	0.	0.	262270.	0.	0.	6047426.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	4560795.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	16127774.
18	LOC-TAXES	0.	0.	-3200000.	0.	667021.	0.	219714.	65844040.
19	SUBTOTALS	79286360.	36852933.	13418891.	187564426.	74534839.	70432980.	953266488.	2142467760.
20	HOUSEHOLDS	3970465.	10369076.	128143400.	0.	31322981.	0.	0.	645319376.
21	STATE-GOV	240398.	28697184.	0.	0.	413300.	1621028.	919318.	103775839.
22	FED-GOV	266914.	907160.	0.	0.	6654910.	0.	2223865.	247847108.
23	TRANSFERS	18222982.	167239452.	0.	0.	1210738.	0.	0.	281489008.
24	PROFITS	358019.	1793155.	-86951454.	0.	10098930.	0.	52003979.	352265988.
25	DEPREC	167350.	28688.	0.	0.	6062026.	0.	0.	139787290.
26	IMP-WYOM	336900.	793260.	16349496.	33659421.	5486634.	2666420.	517053.	318280604.
27	IMP-WORLD	926451.	1166198.	230508532.	103928162.	22116869.	6934960.	7530146.	790815480.
28	TOTALS	103775839.	247847108.	301468868.	325152012.	157901228.	81655388.	1016460848.	5022048384.

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

from within the local economy. This is because the money which it earns from its sales will be spent again in the region. The "basic" or driving industries will usually be characterized by large multipliers.

Several types of multipliers may be calculated. The business multiplier just discussed shows the total business spending within the region per dollar of additional sales to final demand by a given industry.[5] An employment multiplier shows the total added employment in the region per dollar of additional sales to final demand by a given industry. An income multiplier shows the increase of personal income per dollar of additional sales to final demand by a given industry. The multipliers may all include direct, indirect, and induced effects. This means that if a "basic" industry expands its sales to, say, exports by $1,000, it may spend $600 directly on locally produced goods. The producers of these local goods are then indirectly required to purchase some local goods and services themselves in order to meet this additional demand, and so on. The induced impact refers to the assumption that labor hired directly will respend a fixed proportion of its added income stimulating further expansion of the regional economy. Thus, both local producers and local labor are assumed to respend locally part of their increased incomes which resulted from the increased exports by the "basic" industry. The total effect is reflected in the multiplier.

The second forecasting tool provided by the input-output technique is the projection of future business activity by sector or development scenarios. In addition to the projection of dollar sales for each sector, variables which may be assumed to rise proportionately with production

[5]The "direct input requirements per dollar of output are shown in Table 2 and the "direct" plus "indirect" requirements are shown in Table 3. Column sums of Table 3 are the business multipliers. Table 3 is the result of a simultaneous solution of a set of linear equations describing the gross flows among industries shown in Table 1.

TABLE 2
TRI-COUNTY REGION OF SOUTHERN WYOMING - 1977

DIRECT INPUT COEFFICIENTS (% of purchases by sector at top of table from sectors at the left)

		1 AG/LIVESTK	2 COAL-MINES	3 MINES-NEC	4 OIL/GAS-PR	5 CONSTRUCT	6 ALL-MFG	7 TRANS/COMM	8 ELEC/GS-UT	9 WHOLESALE	10 RETAIL
1	AG/LIVESTK	0.121613	0.001859	0.	0.	0.000033	0.	0.	0.	0.	0.
2	COAL-MINES	0.	0.053714	0.	0.	0.	0.	0.	0.144605	0.	0.
3	MINES-NEC	0.	0.	0.010229	0.	0.011384	0.007905	0.	0.000888	0.	0.
4	OIL/GAS-PR	0.	0.	0.	0.058019	0.	0.085758	0.	0.142240	0.	0.
5	CONSTRUCT	0.000096	0.005789	0.004639	0.004183	0.122484	0.008314	0.	0.006831	0.009657	0.004766
6	ALL-MFG	0.020965	0.021827	0.009423	0.010232	0.035951	0.019226	0.046560	0.005498	0.001542	0.018501
7	TRANS/COMM	0.006962	0.001747	0.006899	0.012662	0.006241	0.022835	0.008042	0.000685	0.101031	0.065029
8	ELEC/GS-UT	0.011732	0.002882	0.034094	0.028886	0.001776	0.014375	0.013032	0.022523	0.007455	0.024109
9	WHOLESALE	0.002225	0.000415	0.006481	0.006049	0.003056	0.002917	0.	0.000569	0.000734	0.000658
10	RETAIL	0.072759	0.000085	0.000843	0.001744	0.009228	0.002542	0.000838	0.000127	0.005279	0.003278
11	FIN/INS/RE	0.196776	0.012387	0.	0.004472	0.015443	0.011696	0.001874	0.091534	0.036556	0.047625
12	SERVICES	0.023250	0.007391	0.000373	0.008286	0.015027	0.006241	0.006085	0.000499	0.024385	0.019846
13	MEDICAL	0.000015	0.	0.001016	0.000005	0.000439	0.000062	0.005935	0.	0.000053	0.
14	EDUCATION	0.	0.	0.	0.	0.000823	0.000080	0.	0.	0.000048	0.
15	WATER/SAN	0.000928	0.000019	0.	0.000163	0.000658	0.000096	0.005003	0.000090	0.000358	0.001546
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	LOC-TAXES	0.028865	0.048021	0.026133	0.067249	0.003998	0.015132	0.049302	0.087517	0.017495	0.015665
19	HOUSEHOLDS	0.060669	0.180023	0.218102	0.062288	0.272469	0.147365	0.447767	0.097322	0.232201	0.381195
20	STATE-GOV	0.003578	0.067716	0.014315	0.040431	0.004280	0.005380	0.018850	0.002441	0.010745	0.006919
21	FED-GOV	0.014802	0.138755	0.062429	0.102589	0.043897	0.036000	0.066260	0.018047	0.103233	0.084789
22	TRANSFERS	0.033125	0.002085	0.	0.000753	0.002600	0.001969	0.000316	0.015409	0.006154	0.008017
23	PROFITS	0.034507	0.162696	0.180365	0.405873	0.046604	0.084281	0.087613	0.184305	0.283735	0.223130
24	DEPREC	0.151755	0.077890	0.107189	0.027067	0.047402	0.023853	0.075520	0.150121	0.034776	0.035994
25	IMP-WYOM	0.027952	0.075043	0.136705	0.102754	0.180122	0.292078	0.068346	0.005762	0.018159	0.024220
26	IMP-WORLD	0.187425	0.139656	0.180767	0.056295	0.176085	0.211897	0.098655	0.022990	0.106403	0.034712

TABLE 2 (continued)
TRI-COUNTY REGION OF SOUTHERN WYOMING - 1977

Direct Requirements Per Dollar of Output

		11 FIN/INS/RE	12 SERVICES	13 MEDICAL	14 EDUCATION	15 WATER/SAN	16 LOC-ROADS	17 LOC-GOV	18 LOC-TAXES	19 HOUSEHOLDS	20 STATE-GOV
1	AG/LIVESTK	0.	0.	0.000061	0.	0.	0.	0.	0.	0.003472	0.000002
2	COAL-MINES	0.	0.	0.	0.	0.	0.	0.	0.	0.000055	0.
3	MINES-NEC	0.	0.	0.	0.	0.	0.	0.	0.	0.000548	0.
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	CONSTRUCT	0.000961	0.011904	0.000099	0.022935	0.001271	0.117611	0.053243	0.	0.003694	0.246163
6	ALL-MFG	0.005203	0.007042	0.009008	0.000781	0.000639	0.	0.006706	0.	0.020083	0.006426
7	TRANS/COMM	0.005646	0.024380	0.007637	0.018214	0.003548	0.001929	0.009828	0.005185	0.025620	0.001827
8	ELEC/GS-UT	0.002204	0.024260	0.002654	0.024857	0.030557	0.005482	0.019325	0.	0.021756	0.000333
9	WHOLESALE	0.000031	0.013430	0.001708	0.002946	0.	0.039543	0.003922	0.	0.024680	0.000630
10	RETAIL	0.001829	0.011354	0.003839	0.000693	0.017643	0.032061	0.014989	0.	0.117652	0.002457
11	FIN/INS/RE	0.004937	0.054620	0.028896	0.016717	0.415651	0.005818	0.025908	0.	0.088729	0.000687
12	SERVICES	0.016888	0.032286	0.012176	0.018603	0.008175	0.001754	0.011589	0.	0.045327	0.006567
13	MEDICAL	0.	0.	0.037607	0.000163	0.	0.	0.034791	0.111137	0.043897	0.003221
14	EDUCATION	0.	0.000095	0.	0.000385	0.	0.	0.	0.453136	0.005942	0.495684
15	WATER/SAN	0.000202	0.005329	0.000669	0.001599	0.	0.008770	0.001260	0.005516	0.005680	0.000020
16	LOC-ROADS	0.	0.	0.	0.	0.	0.	0.	0.069267	0.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.	0.	0.244939	0.	0.
18	LOC-TAXES	0.002919	0.014420	0.010281	0.	0.	0.	0.	0.	0.013410	0.
19	HOUSEHOLDS	0.081849	0.308987	0.247461	0.542237	0.227783	0.316610	0.447301	0.	0.003163	0.038260
20	STATE-GOV	0.002067	0.003318	0.000069	0.013633	0.	0.	0.010286	0.	0.054509	0.002317
21	FED-GOV	0.026005	0.049145	0.020448	0.008819	0.001508	0.000439	0.003722	0.	0.172724	0.002572
22	TRANSFERS	0.569407	0.009195	0.004864	0.048275	0.069970	0.000979	0.046349	0.	0.014936	0.175599
23	PROFITS	0.075343	0.141037	0.482926	0.135646	0.007901	0.011182	0.201249	0.110820	0.035098	0.003450
24	DEPREC	0.005757	0.065628	0.018835	0.	0.014145	0.	0.	0.	0.	0.001613
25	IMP-WYOM	0.142077	0.067085	0.047860	0.071387	0.032641	0.124104	0.018146	0.	0.056798	0.003246
26	IMP-WORLD	0.056673	0.156483	0.062899	0.072108	0.168568	0.333718	0.091386	0.	0.242225	0.008927

TABLE 2 (continued)
TRI-COUNTY REGION OF SOUTHERN WYOMING - 1977

Direct Requirements Per Dollar of Output

TABLE 2 (continued)

TRI-COUNTY REGION OF SOUTHERN WYOMING

Direct Requirements Per Dollar of Output

		21 FED-GOV	22 TRANSFERS	23 INVESTMENT	24 OIL-R+D	25 EXP-WYOM	26 EXP-WORLD
1	AG/LIVESTK	0.	0.	0.	0.001900	0.125893	0.069023
2	COAL-MINES	0.	0.	0.062432	0.	0.	0.177404
3	MINES-NEC	0.	0.	0.	0.000008	0.	0.378099
4	OIL/GAS-PR	0.	0.	0.	0.	0.	0.146755
5	CONSTRUCT	0.085370	0.003071	0.373615	0.367628	0.	0.
6	ALL-MFG	0.000034	0.	0.	0.002879	0.040980	0.062549
7	TRANS/COMM	0.003229	0.	0.	0.016916	0.	0.050114
8	ELEC/GS-UT	0.000591	0.	0.	0.003353	0.462118	0.029692
9	WHOLESALE	0.000532	0.	0.072578	0.006786	0.041221	0.
10	RETAIL	0.000423	0.000838	0.051558	0.007237	0.058544	0.002979
11	FIN/INS/RE	0.000064	0.	0.	0.045549	0.	0.
12	SERVICES	0.002161	0.016970	0.016669	0.013839	0.	0.013309
13	MEDICAL	0.000629	0.034246	0.	0.000053	0.	0.000984
14	EDUCATION	0.055660	0.	0.	0.	0.133809	0.006703
15	WATER/SAN	0.	0.	0.	0.001661	0.	0.
16	LOC-ROADS	0.	0.	0.	0.	0.	0.
17	LOC-GOV	0.	0.	0.	0.	0.	0.
18	LOC-TAXES	0.	-0.010615	0.	0.004224	0.	0.000216
19	HOUSEHOLDS	0.041837	0.425063	0.	0.198371	0.	0.
20	STATE-GOV	0.115786	0.	0.	0.002617	0.019852	0.000904
21	FED-GOV	0.003660	0.	0.	0.042146	0.	0.002188
22	TRANSFERS	0.674769	0.	0.	0.007668	0.	0.
23	PROFITS	0.007235	-0.288426	0.	0.063957	0.	0.051162
24	DEPREC	0.000116	0.	0.	0.038391	0.	0.
25	IMP-WYOM	0.003201	0.054233	0.103519	0.034747	0.032655	0.000509
26	IMP-WORLD	0.004705	0.764618	0.319629	0.140068	0.084930	0.007408

TABLE 3
TRI-COUNTY REGION OF SOUTHERN WYOMING (Households in Processing Sector)

Direct and Indirect Requirements Per Dollar Delivered to Final Demand - 1977

		1 AG/LIVESTK	2 COAL-MINES	3 MINES-NEC	4 OIL/GAS-PR	5 CONSTRUCT	6 ALL-MFG	7 TRANS/COMM	8 ELEC/GS-UT	9 WHOLESALE	10 RETAIL
1	AG/LIVESTK	1.1392	0.0033	0.0012	0.0006	0.0016	0.0009	0.0023	0.0013	0.0014	0.0020
2	COAL-MINES	0.0037	1.0587	0.0069	0.0058	0.0025	0.0040	0.0050	0.1586	0.0032	0.0065
3	MINES-NEC	0.0004	0.0005	1.0108	0.0004	0.0138	0.0085	0.0009	0.0014	0.0005	0.0007
4	OIL/GAS-PR	0.0067	0.0048	0.0085	1.0688	0.0073	0.0976	0.0107	0.1584	0.0048	0.0098
5	CONSTRUCT	0.0046	0.0113	0.0092	0.0096	1.1438	0.0132	0.0070	0.0159	0.0152	0.0110
6	ALL-MFG	0.0338	0.0315	0.0187	0.0167	0.0536	1.0288	0.0639	0.0190	0.0173	0.0370
7	TRANS/COMM	0.0250	0.0143	0.0203	0.0221	0.0260	0.0352	1.0334	0.0157	0.1183	0.0884
8	ELEC/GS-UT	0.0242	0.0125	0.0448	0.0378	0.0160	0.0258	0.0323	1.0377	0.0210	0.0423
9	WHOLESALE	0.0083	0.0077	0.0143	0.0107	0.0143	0.0097	0.0153	0.0085	1.0106	0.0145
10	RETAIL	0.1071	0.0321	0.0357	0.0195	0.0584	0.0299	0.0696	0.0299	0.0490	1.0656
11	FIN/INS/RE	0.2552	0.0442	0.0357	0.0260	0.0634	0.0399	0.0689	0.1262	0.0795	0.1089
12	SERVICES	0.0444	0.0235	0.0169	0.0185	0.0401	0.0205	0.0382	0.0194	0.0465	0.0502
13	MEDICAL	0.0142	0.0192	0.0190	0.0164	0.0208	0.0143	0.0405	0.0251	0.0212	0.0283
14	EDUCATION	0.0208	0.0280	0.0189	0.0370	0.0108	0.0154	0.0333	0.0535	0.0171	0.0189
15	WATER/SAN	0.0030	0.0022	0.0022	0.0018	0.0036	0.0020	0.0092	0.0026	0.0036	0.0056
16	LOC-ROADS	0.0030	0.0040	0.0026	0.0055	0.0011	0.0021	0.0046	0.0080	0.0023	0.0024
17	LOC-GOV	0.0106	0.0143	0.0093	0.0195	0.0040	0.0075	0.0162	0.0282	0.0081	0.0085
18	LOC-TAXES	0.0433	0.0584	0.0378	0.0798	0.0165	0.0308	0.0659	0.1150	0.0329	0.0349
19	HOUSEHOLDS	0.1892	0.2604	0.2874	0.1396	0.3952	0.2225	0.5672	0.2353	0.3578	0.5129

TABLE 3 (continued)
TRI-COUNTY REGION OF SOUTHERN WYOMING (Households in Processing Sector)

Direct and Indirect Requirements Per Dollar Delivered to Final Demand - 1977

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

may also be estimated. Employment, water use, population, and energy use are examples of variables which may be projected in this manner.

Projections of future economic activity are derived from the input-output model by focusing on the "basic" or driving industries. Examination of the size of the multipliers and the size and expected growth of the basic industries reveals the key sectors. Estimates of expected export growth in these sectors must be obtained in order to drive the input-output model. Scenarios for growth in these sectors might be constructed from information obtained from personal interviews with representatives of major firms in each sector. Government growth estimates are often available directly from the relevant government agencies. The expected growth estimates for the basic industry and government sectors are introduced into the input-output model to generate new, consistent estimates of the value of sales for each industry. A more detailed explanation of I-O techniques may be found in (41) or in many of our reports listed in the reference section.

E. Extensions of the Input-Output Model

In addition to its conversion to a linear programming framework, as discussed briefly in the following section, the input-output model has the flexibility to be adapted in many ways according to the needs of the researcher. A few of many possible applications are discussed here.

Forecasting Population Change: Employment-related population change can be projected by an input-output model if employment for each industry and sector can be assumed proportional to the output of that sector and further that family size and workers per family are also constant over time. Ideally, each sector would not only have a unique ratio of employment to output, but also each industry would have a unique ratio of population to

worker (the ratio of persons per family divided by workers per family). Projections by the input-output model of output per sector could then be converted into estimates of both employment and population change (if the unemployment rate in the region was assumed constant). After adjusting for natural population growth in the region, the net migration implied by the projection of output change could also be determined. A computer model to allow economic analyses such as this and which may be accessed interactively from remote terminals is currently under development. It should be available for use in 1980.

Modeling Transitory Impacts: The basic input-output model incorporates households into the processing sector which implies that local purchases by households grow along with household incomes. Some household purchases may be exogenously determined however. In like manner, other industries in the processing sector may have both endogenous and exogenous components within their bill of purchases. One example of this would be the effects of unexpected weather impacts on spending for space heating (32). The input requirements shown by the transactions table reflect normal weather expectations. Abnormal conditions would result in temporary and exogenously determined changes in energy purchases. Such purchases are easily modeled by including an extra column in the final demand sector which shows purchases from the energy sectors which are brought about by exogenous changes in weather.[7]

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[7]A second example would be the temporary hiring of labor by firms impacted by short-run increases in demand. High labor to capital ratios might appear as firms resort to inefficient means to meet sudden changes in demand. In the longer run, the labor to capital ratio would return to that shown by the transactions table, either because added capital has been put in place or because the temporary short-run or unexpected demands have abated.

Modeling Distributional Effects: The makeup of an economy may change as it develops over time. Each industry has a unique distribution of job classifications which it requires. Each industry also has a unique makeup of income levels for its workers. The distribution of workers by occupation or by income can be projected via the input-output model. The occupational distribution is easily determined by simply weighting the distributions for each sector by the percentage of employment contained in that sector. Projection of changes in income distribution could be accomplished in like manner. However, if the pattern of consumer spending differs by income level, increased accuracy in predicting regional economic change can be accomplished by disaggregating the household sector into several income classes. As the economy develops, some income classes will grow faster than others and this, in turn, will result in changes in the effective household consumption spending patterns.

F. A Further Application of the Input-Output Model

The conventional input-output projections assume no resource constraints. That is, each sector is free to expand to meet demands placed on it by other expanding sectors or by sales to final demand. It is possible that limited supplies of crucial resource inputs such as land and water could create "bottlenecks" (12, 17). Two alternatives exist: (1) necessary scarce inputs may be imported by those industries requiring them, or (2) all industries which depend on scarce products as inputs cease to grow. Various scenarios of this type can be investigated utilizing the input-output model and the related linear-programming technique. This is one of the many options for research presented by the versatile input-output model.

The true power of the input-output technique rests in its application as an analytical tool to aid decision making. Assumptions about growth in

various economic sectors may be made and the impacts to regional economy may be quantitatively measured.

Great value lies in the speed with which this may be accomplished. By changing several data entries in the computerized model, new projections can be made in a very short time period. The benefits in this are that a number of scenarios may be tested rapidly and the effects of each compared on similar grounds. This can greatly assist professional planning staff and elected officials in determining the impacts of decisions which could affect the regional economy.

To maintain the model and insure that the data are current, a periodic updating is required. Funding resources and staff time must be available for this purpose if this is to be a useful planning tool. Examples of the wide variety of possible applications for the I-O technique are shown by (3, 6, 8, 11, 12, 13, 14, 15, 16, 17, 18, 26, 27, 28, 30, 32, 36, 45).

IV. SOURCES OF INFORMATION FOR AN INPUT-OUTPUT MODEL

A. Questionnaire Design and Use

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

Accordingly, all interviews are conducted in a basic accounting language tailored to the individual firms involved and the researcher translates the information to SIC classification. Thus, the sample questionnaire form shown in Table 4 represents the format for the final translation by the researcher.

Not all interviews can, however, be conducted as planned. It has been found, for example, that some firms will have to refer for legal advice while others did not want to reveal information in the form desired. Even though primary data is not solicited through the mail, it is necessary to design a questionnaire for use both as an interview focal point and as an item that can be left with an interviewed firm.

The questionnaire includes a cover sheet used to briefly explain the nature of the research and to solicit information on the nature of the firm's product lines, the number of employees, water use, and level of capacity utilization. Outlay patterns, both of a cash flow and a non-cash flow nature, are the concern of the second sheet. Information on sales distribution is solicited on the third. Both sales and outlay patterns are disaggregated by interindustry study sector descriptions and regionalized according to (1) study region, (2) in-state other than the study region, and (3) activity outside the state. A question on water use is included to provide information on sector-by-sector water withdrawals.

B. Conduct of the Survey and Processing the Data

Interview schedules are arranged in advance by telephone. Every effort is made to gain an interview with the person who would have immediate authority to realease information. The length of time spent on an individual interview varies from firm to firm. Some will be conducted in less than an hour; some take place over several days. The total survey may be conducted over a period of many months.

TABLE 4

Colorado School of Mines
golden, colorado 80401 • (303) 279-0300

mineral economics department

VOLUNTARY QUESIONNAIRE

Albany, Sweetwater, and Carbon Counties Inter-Industry Analysis

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

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

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

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

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

Name of Firm: _____

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

_____

_____

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

Full Time: _____ Part Time: _____

TABLE 4 (continued)

SALES ANALYSIS

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

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

TOTAL WATER INTAKE: _____

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

DEPLETION ALLOWANCE: _____

TABLE 4 (continued)

PURCHASES ANALYSIS

SUPPLY SOURCE: SECTORS FROM WHICH YOU PURCHASE OR PAY EXPENSES	PURCHASES IN SWEETWATER, CARBON AND ALBANY COUNTIES ($ or % or Total)	PURCHASES FROM OTHER WYOMING COUNTIES ($ or % or Total)	PURCHASES OUTSIDE WYOMING ($ or % of Total)
1. AGRICULTURE, LIVESTOCK AND FORESTRY			
2. COAL MINES AND RELATED SERVICES			
3. OIL AND NATURAL GAS PRODUCERS			
4. ALL OTHER MINING AND RELATED SERVICE OPERATORS			
5. ALL CONSTRUCTION			
6. ALL MANUFACTURING (includes processed foods, lumber, chemicals, oil refining, stone, glass, metals, machines, transportation equipment, office equipment, furniture)			
7. ALL TRANSPORTATION AND COMMUNICATION (includes radio, t.v., advertising, cable subscriptions, telephone)			
8. ELECTRICITY AND GAS UTILITIES			
9. WHOLESALE TRADE (wholesaling intermediaries)			
10. RETAIL TRADE (all retail trade)			
11. FINANCE, INSURANCE, AND REAL ESTATE (interest payments, insurance premiums, real estate commissions, and management fees, fees and charges by brokers)			
12. ALL OTHER SERVICES (lodging, legal, personal, leasing, amusement, data processing, business, repair, etc.)			
13. HEALTH SERVICES (medical, dental, hospitals, laboratories, patient care facilities)			
14. EDUCATIONAL SERVICES (primary, secondary, college, technical, professional, libraries)			
15. WATER, SEWAGE, TRASH REMOVAL			
16. LOCAL AND COUNTY GOVERNMENT (taxes, permits, licenses)			
17. HOUSEHOLDS (payments subject to withholdings)			
18. WYOMING STATE GOVERNMENT (taxes, permits, licenses)			
19. FEDERAL GOVERNMENT (taxes, permits, license fees, employers FICA, unemployment insurance)			
20. RENTS, DIVIDENDS, RETAINED EARNINGS			
21. DEPRECIATION ALLOWANCE			
22. TOTAL PURCHASES			

Please indicate the value of your establishment's net inventory change in 1978 (this may be a positive or negative).
NET INVENTORY CHANGE: $ _____.

Information gathered on the outlay and sales patterns for any given enterprise is tabulated to conform to sector delineations and regional descriptions shown in Table 4. Care is exercised at this step to assure a balance between outlays and sales. Any anomalies are checked and corrected before proceeding further.

The next step is to aggregate questionnaire forms within a sector and to expand the information to represent gross flows. Typically, industry employment totals are used to expand survey data using the survey ratio of sales to employment. The gross flows identified in this manner provide the industry sales totals for the initial transactions statement.

C. Typical Data Sources by Sector (in Colorado)

This section is devoted to the presentation of an annotated bibliography of the information sources which have been found superior in Colorado. A similar compilation is under way for data in Wyoming. A number of alternative sources were available which were not used. The selection of the best information and the methods of attaining it are discussed in greater detail in (19, 29, 31).

Agricultural Production SIC 01,02,07

Colorado. Department of Agriculture. Colorado Crop and Livestock Reporting Service. Colorado Agricultural Statistics. Annual.

Colorado State University. Cooperative Extension Service Data. Department of Economics.

Industry survey data.

U.S. Department of Commerce. Bureau of the Census. Census of Agriculture: 1974. Volume 1, Area Reports, part 41, Colorado, Section 2, County Data. Washington, D.C.: Government Printing Office, 1972.

Special consideration must be given to the estimation of hay sales and livestock sales. These are not available in appropriate form from Colorado Agricultural Statistics.

Coal Production SIC 12

Colorado. Department of Natural Resources. Division of Mines. A Summary of Mineral Industry Activities in Colorado. Part I: Coal. Annual.

Colorado. Public Utilities Commission. File.

Hebb, D. H. and M. S. Curtin. "Colorado Coal: A Production and Shipment Director." (U.S. Department of Interior, Bureau of Mines.) Golden, Colorado: Colorado School of Mines Mineral Economics Institute, 1977. (Photocopy reproduction.)

Industry survey data.

Data on tonnage and labor days are available in the Division of Mines publication on a mine-by-mine basis. The PUC files, the Hebb-Curtin study, and survey information provide the data used in estimating price.

Metal Mining, Oil and Natural Gas Production, and Nonmetal Mining SIC 10,13,14

Colorado. Department of Natural Resources. Division of Mines. A Summary of Mineral Industry Activities in Colorado. Part II: Metal-Nonmetal. Annual.

Colorado. Department of Natural Resources. Oil and Gas Conservation Commission. Oil and Gas Statistics. Annual.

Industry survey data.

Perderson, John A. and Oded Rudawsky. "The Role of Minerals and Energy in the Colorado Economy." (U.S. Bureau of Mines Grant No. G-0122090.) Golden, Colorado: Department of Mineral Economics, Colorado School of mines, 1974. (Photocopy reproduction.)

Total gross output values for metal mining, oil and natural gas production, and nonmetal mining are taken from the State of Colorado publications. Interindustry flows are estimated by using the Pederson-Rudawsky study adjusted and updated with information gained in independent surveys and using both Nelson and Wholesale Price Indices.

Construction SIC 15,16,17

Colorado. Department of Labor and Employment. Files.

Industry survey data.

Information gained by interviews with contractors is used to calculate a ratio between contract value and outlay for labor on a two-digit SIC level. This ratio is then applied to the annualized employment and wage data provided by the Colorado Department of Labor and Employment to estimate total gross output.

Manufacturing SIC 20,23,25,27,28,29,32,33,34,35,38,39

Colorado. Department of Labor and Employment. Colorado Manpower Review. Monthly.

Colorado. Department of Labor and Employment. Files.

Industry survey data.

Information gained by interviews is used to calculate a ratio between total gross output value and outlay for labor on a two-digit SIC level. This ratio is then applied to the annualized employment and wage data provided by the Colorado Department of Labor and Employment to estimate total gross output at the two-digit level.

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

Colorado. Department of Labor and Employment. Files.

Colorado. Public Utilities Commission. Files.

Colorado. State Auditor. Files.

Industry survey data.

Information pertinent to railroad and telephone communications is gained from filed PUC reports and survey. Because of the nature of the accounting systems employed by the firms involved, a significant amount of prorating is required to allocate the data to approximate the study region.

Where the airports are operated by local public authorities, the relevant information is obtained from reports filed with the Colorado State Auditor.

Data on employment and earnings for components other than rail and air transportation sectors are obtained from the Colorado Department of

Labor and Employment and the survey provides an estimation for the output level.

Electric and Natural Gas Utilities SIC 491,492,493

Colorado. Department of Labor and Employment. Files.

Colorado. Public Utilities Commission. Files.

Colorado. State Auditor. Files.

Industry survey data.

A certain amount of prorating and imputation is also involved in this sector to match the geographic location of activity to the study region. Electric activities under the control of local public authorities are identified by examining reports filed with the State Auditor. Inforamtion gained from the Colorado Department of Labor and Employment and from interviews provides cross checks throughout the estimation of the activities of this sector.

Wholesale Trade SIC 50,51; also

Retail Trade SIC 52,53,54,55,56,57,58,59

Colorado. Department of Labor and Employment. Colorado Manpower Review. Monthly.

Colorado. Department of Labor and Employment. Files.

Colorado. Department of Revenue. Annual Report. Annual.

Industry survey data.

Interviews conducted for the study are used to determine the basic outlay patterns for the trade sectors. Convention dictates that the trade sectors are entered in the interindustry model at the level of gross margins. The reasoning behind this is to facilitate showing the direct economic links between producers and users. The absence of margining would interject the huge trade sector dollar turnover between producers and consumers. Thus, the output of local producers is first distributed to the various sectors in accordance with survey findings. Then, where the output, e.g., milk

products, ordinarily goes first to trade sector, e.g., grocery stores, before going to a regional user, e.g., households in the model, the sale is made directly. A margin on the sale is attributed to the trade sector. Merchandise imports by the trade sectors are prorated and assigned to the various regional sectors based on the relative volumes of purchases from the trade sectors.

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

Colorado. Department of Labor and Employment. Colorado Manpower Review. Monthly.

Colorado. Department of Labor and Employment. Files.

Colorado. Department of Regulatory Agencies. Division of Insurance. Insurance Industry in Colorado: Statistical Report. Annual.

Colorado. Department of Revenue. Annual Report. Annual.

County Clerk Office, respective counties. Files.

Federal Credit Banks of Wichita. Files.

Federal Home Loan Bank Board. Combined Financial Statements - Member Savings and Loan Associations of the Federal Home Loan Bank System. Annual.

Industry survey data.

Sheshunoff & Company, Inc. The Banks of Colorado. (A private publication.) Annual.

The output value of the finance sector is entered in the interindustry model as the estimated value of interest charges incurred within the region. Interest earnings by commercial banks are readily identified in the Sheshunoff publication; likewise, the Federal Credit Banks of Wichita provide data relevant to the operations of the Production Credit Association and Federal Land Bank Association. Regional information on the activities of savings and loan associations is not readily available so that data published for Colorado in the Federal Home Loan Bank Board's Combined Financial Statements

are prorated by a wage and salary formula for the study region. Survey data are used both as a cross check to published data and to estimate financing from outside the region, e.g., certain school bonds, Rural Electrification Association loans, insurance company loans, and so forth.

Information gained in interviews with several major insurance companies suggests that a precise accounting for insurance premiums paid on per country basis is a near impossibility. Another difficulty observed is with respect to loss claims; specifically, in a small region the losses incurred by any one economic sector cannot be predicted with any certainty. Thus, the insurance sector is handled as follows.

Gross insurance premiums paid in the study region are approximated by prorating premiums paid in the State of Colorado by a personal adjusted gross income figure. Premiums paid in Colorado are reported in the State Division of Insurance's Statistical Report; personal income is reported in the Department of Revenue's Annual Report. The state loss experience ratio is then used to split gross premiums paid; the loss portion is charged to the transfer account in the model and the balance is charged as gross output of the insurance sector. Accordingly, the transfer row collects the portion of premiums paid that subsequently reimburses for losses and the transfer account column distributes the same to contractors, auto dealers, health practitioners, and so forth.

Information on documentary fees paid for real estate transactions can be secured from the county clerks in the respective counties. The fee information is used to estimate the gross value of transactions and survey information is used to estimate the commissions which make up the gross output of the real estate sector.

Survey information provides the means to construct the distribution of the total gross outlays in the finance, insurance, and real estate sector.

Services SIC 70,72,73,74,75,76,78,79,81,86,89

Colorado. Department of Labor and Employment. Colorado Manpower Review. Monthly.

Colorado. Department of Labor and Employment. Files.

Colorado. Department of Revenue. Annual Report. Annual.

Industry survey data.

U.S. Department of Commerce. Bureau of the Census. Census of Selected Service Industries, 1972: Area Series, Colorado, 72-A-6. Washington, D.C.: Government Printing Office, 1974.

Sales by the hotels and other lodging facilities sector were estimated by annualizing the pertinent information reported in the Department of Revenue's Annual Report.

Estimation of the output value of service sectors (excluding lodging) is accomplished as follows. The Census of Selected Service Industries provides information on output and employment in the study counties and the entire state for 1972. Census disclosure requirements cause a considerable amount of data aggregation to take place at the county level. Thus, by using Department of Labora and Employment data for the respective counties and Colorado productivity ratios, calcultated for the Census, the reported county output data are disaggreagted on a three-digit SIC basis. Outlay distributions are estimated from information gained by interviews.

The ski industry was surveyed for the 1977-78 season and a separate sector designed accordingly. (In the Colorado Upper Mainstem Study.)

Health SIC 80

Colorado. Department of Labor and Employment. Files.

Colorado. Department of Revenue. Annual Report. Annual.

Colorado. State Auditor. Files.

Industry survey data.

Health facilities owned by local public authorities have current financial

statements on file with the State Auditor. The deliveries of services in nursing home situations are obtained from survey.

Education SIC 82

Colorado. Department of Education. Files.

Colorado. Department of Education. Revenues and Expenditures: Colorado School Districts. Annual.

Industry survey data.

Information on public school districts is published on an annual basis in Revenues and Expenditures. Information on colleges and universities and Colorado State Extension Services can be secured directly.

Water, Sewer, and Trash SIC 494,495,496,497; also

Local and County Roads; also

Local and County Government; also

Local and County Taxes

Colorado. State Auditor. Files.

Industry survey data.

The 1977 audit reports for all local and county government authorities are examined and that data contained therein are aggregated. Information gained in select interviews facilitates the distribution of the various sectors' outlays.

Households

Colorado. Department of Labor and Employment. Files.

Colorado. Department of Revenue. Annual Report. Annual.

Colorado. Public Employees Retirement Association. Files.

Community Services Administration. Federal Outlays in Colorado. Annual. (Prior to fiscal 1975 published by Office of Economic Opportunity.)

Industy survey data.

U.S. Department of Commerce. Bureau of the Census. Census of the Population, 1970: General Social and Economic Characteristics, Final Report, Colorado, PC (1)-C7. Washington, D.C.: Government Printing Office, 1972.

U.S. Department of the Treasury. Internal Revenue Service. Statistics of Income 1969, ZIP Code Area Data from Individual Income Tax Returns. Washington, D.C.: Government Printing Office, 1972.

Household income is shown as emanating from wages and salaries subject to withholding, proprietorship, partnership, and Sub-Chapter S Corporation income, interest, rent and dividend income, and transfer payments.

The Department of Revenue's Annual Report publishes personal adjusted income figures on a county basis.

Audit reports for the respective counties provides information on the level of payments made to households by the five counties' departments of social services. An estimate of payments by the Colorado Public Employees Retirement Association is based on information provided by the Association. The value of transfer payments made by the U.S. Government is approximated by the reported information in Federal Outlays. Life insurance distributions are estimated in accordance with the procedure previously described in the insurance section.

Payments made to the household account by the respective regional economic sectors reflect an estimate of wages paid subject to withholding. For most of the private enterprise portion of the economy, this estimate reflects the place of work data base provided by the Colorado Department of Labor and Employment files. Estimates on the earnings of agricultural, railroad, and government employees reflect the information sources peculiar to those sectors. The household-on-household cell is imputed by taking the domestic employment figure from the Census of Population and annualizing a $2.75 wage rate. The transfer column entry for households is a closing entry. Essentially it is an entry that brings non-wage and salary income to the household sector.

Households are not surveyed to gain information on their outlay patterns. Rather, there is a reliance on the sales information provided by regional producers. Accordingly, the import figure aside from the post marginal trade sector merchandise, for households is largely a residual value.

State Government; also

Federal Government

Colorado. Department of Education. Revenues and Expenditures: Colorado School Districts. Annual.

Colorado. Department of Highways. Colorado's Annual Highway Report. Annual.

Colorado. Department of Natural Resources. Division of Wildlife. Colorado Big Game Harvest. Annual.

Colorado. Department of Natural Resources. State Board of Land Commissioners. Summary of Transactions. Annual.

Colorado. Department of Planning and Budget. Files.

Colorado. Department of Revenue. Annual Report. Annual.

Colorado. State Auditor. Files.

Colorado. Public Employees Retirement Association. Files.

Colorado. Public Utilities Commission. Files.

Community Services Administration. Federal Outlays in Colorado. Annual. (Prior to fiscal 1975 published by Office of Economic Opportunity.)

Sheshunoff & Company, Inc. The Banks of Colorado. (A private publication.) Annual.

U.S. Department of the Treasury. Bureau of Government Financial Operations. Combined Statement on Receipts, Expenditures, and Balances of the United States Government. Washington, D.C.: Government Printing Office. Annual.

U.S. Department of the Treasury. Internal Revenue Service. Statistics of Income 1969, ZIP Code Area Data from Individual Income Tax Returns. Washington, D.C.: Government Printing Office, 1972.

Total gross output for the government sectors is defined in terms of the estimate of revenues from all sources. For private enterprise in the

endogenous portion of the model, an estimate is made of income and payroll tax liabilities and fees and royalties paid by each respective sector. There is no real cross check against these estimates because neither Colorado nor the U.S. Government reports business tax liabilities on a county basis. Further, previous research experience has demonstrated that prorating the reported state level of collections (reported in the Treasury's Combined Statement of Receipts, Expenditures, and Balances and the Department of Revenue's Annual Report) by such factors as population or personal income produces questionable results.

Personal tax and fee liabilities are much more readily estimated by using such publications as the Department of Revenue's Annual Report, the Division of Wildlife's Big Game Harvest, and the IRS's ZIP Code Area Data. The exports by the State of Colorado include estimates of sales taxes.

For the U.S. Government, the publication Federal Outlays is used as a first approximation of expenditures. Select interviews with the larger agencies, such as the U.S. Forest Service, Bureau of Land Management, and U.S. Postal Service, provide the information to estimate agency operating expenditure patterns. Information on direct payments for such things as schools, interest on government securities held by commercial banks, highways, and local government activities is taken from the Colorado Department of Education's Revenues and Expenditures, Sheshunoff's The Banks of Colorado, Colorado's Annual Highway Report, and files in the Colorado State Auditor's Office.

State of Colorado expenditures are first approximated by information contained in regionalized budgets provided by the Department of Planning and Budget. This information is on a state planning region basis and is designed for State analysis for the yearly budget, so modification is necessary on an

agency basis. Contacts are made with the larger agencies such as the Division of Wildlife and the State Department of Highways to accommodate this requirement.

Transfer Account

The transfer account is an accounting device that allows for two unique and distinctive characteristics that are not found in conventional regional interindustry studies. First, the assumption that transfer payments cancel in the net is dropped. Second, the model handles financial balances in such a manner as to give rise to a definition of regional income more analogous to the definition of national income.

Investment

Survey information is used to estimate the investment column and mineral research and development column. The value of these investments is then set against the value of the profit and depreciation rows. Out of the net difference, the estimate of entrepreneurial income is taken and closed to households; the residual after accounting for entrepreneurial income is treated as a regional capital shortage.

Employment

Colorado. Department of Labor and Employment. Files.

No single source or agency seems to be able to provide an adequate estimate of annualized full-time equivalent employment in agriculture. Consequently, using Colorado State University farm and ranch survey data collected for the study, Impacts of Federal Grazing on the Economy of Colorado, and wage rates published in the Colorado Agricultural Statistics, full-time employment equivalents are imputed. Employment by government agencies is estimated by using survey information.

Caution is exercised to the fact that employment levels are defined in the I-O models do not approximate employment levels as defined in some

commonly distributed publications. The Colorado Manpower Review, for example, publishes county estimates on the resident adjusted labor force. Aside from the definitional difference, and the fact that employment by industry is not reported for low population counties, the current method used to estimate the resident adjusted labor force is extremely questionable. The reader is referred to the January 1977 Manpower Review for a complete discussion on this matter.

V. SURVEY BASED INPUT-OUTPUT MODELS COMPLETED OR IN PROGRESS AT COLORADO STATE UNIVERSITY AND COLORADO SCHOOL OF MINES

(Economics Department and Minerals Economics Department)

A. Studies Completed as of November 1979

The Economy of Northwestern Colorado: Description and Analysis (also Executive Summary and The Analytical Framework), contract report, Bureau of Land Management, March 1977. This study analyzes the economy comprised of Delta, Eagle, Garfield, Mesa, Moffat, Montrose, Pitkin, Rio Blanco, and Routt Counties plus the Somerset coal area of Gunnison County.

The Economy of Moffat, Routt, and Rio Blanco Counties, Colorado, Description and Analysis, contract report, Bureau of Land Management, November, 1978.

An Input-Output Study of the Upper Colorado Mainstem Region of Western Colorado, contract report, Bureau of Land Management, July, 1979. This study analyzes the economy comprised of Eagle, Garfield, Mesa, Pitkin and Summit Counties.

An Economic Analysis of Water Use in Colorado's Economy, contract report, OWRT, fifth printing, Environmental Resources Center, Colorado State University, December, 1975. This study comprises the total Colorado State economy.

An Economic Analysis of Water Use in Boulder, Larimer, and Weld Counties Colorado with Projections to 1980, contract report, Bureau of Reclamation, March, 1974.

Future Economic Trends Input-Output Analysis, Interindustry Analysis and Economic Profile of the Larimer-Weld Region, consulting report, Larimer-Weld Regional Council of Governments, December, 1976, Vol. I: Final Report, Vol. II: Technical Appendices, Vol. III: Executive Summary.

The Economy of Albany, Carbon and Sweetwater Counties, Wyoming, Description and Analysis, contract report, Bureau of Land Management, July, 1980.

An Interindustry Model of Greeley, Colorado, For the Study of Space Heating Energy Requirements, contract report, Department of Energy, April, 1980.

B. Studies in Progress

An unpublished model is available for Garfield, Mesa, Moffat, Rio Blanco, and Routt Counties, Colorado, January, 1978.

A model is in progress for Colorado State Planning Region One (Morgan, Logan, Sedgwick, Phillips, Washington, and Yuma Counties).

A model is in progress for the Colorado High Plains over the Ogallala Acquifer (Baca, Cheyenne, Kowa, Kit Carson, Lincoln, Logan, Phillips, Prowers, Sedgwick, Washington and Yuma Counties).

A model is in progress for the Kremmling Region of Colorado (Jackson and Grand Counties).

A model is in progress for Colorado State Planning Region Two (Larimer and Weld Counties).

A number of other models in the region are in their preliminary stages or have been proposed. The data collection effort is either under way or completed for the models listed above as in progress.

GLOSSARY OF TERMS

Final Demand: Final demand is the dollar value of goods and services purchased by the final consumer during a specified accounting period. The final demand sectors are governments, exports, and capital formation.

Intermediate Demand: Contrasted to final demand, intermediate demand is the dollar value of goods and services which are sold by one producer to another and which are further processed before being delivered to the final user.

Basic Industry or Basic Sector: Those industries or industries aggregated into economic sectors which typically ship a significant portion of their output outside the region. Basic industry is only a part of the final demand or driving sector.

"Driving" Sectors: The "driving" sectors of the regional economy are the components of final demand. Production in the regional economy occurs in response to (is "driven" by) the levels of final demand.

Business Multiplier: The business multiplier estimates the total dollar value of production generated in an economy in response to a one-dollar increase in the final demand for the output of a specific economic sector.

Income Multiplier: These multipliers are estimates of the total change in household income which results from a one dollar change in final demand for the output of any specific sector of the regional economy.

Employment Multiplier: The employment multipliers estimate the total employment generated in the regional economy in response to an increase in final demand for the output of any specific sector.

Growth Scenario: Growth scenario refers to a set of assumed futures, relating specifically to growth in final demand, from which are derived estimates of economic activity, employment, and income in the regional economy.

Induced Impact: Induced impacts are the impacts on economic activity, employment, and household income which result from increased household spending.

Provisional Forecast: These forecasts are estimates of future value of economic variables which are conditioned by the specified levels of growth in final demand. It is assumed that the relationship between final demand and the economic variables to be projected is known and remains constant over the forecasting period.

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