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The Economic Contribution of the Sugarbeet Industry of Eastern North Dakota & Minnesota

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Preface

The work upon which this report is based was partially supported by funds from the Sugarbeet Research and Education Board of Minnesota and North Dakota. The purpose of this research was to estimate the economic contribution the sugarbeet industry, including the production and processing of sugarbeets, makes to the economies of North Dakota and Minnesota. Outside of the geographic area involved in the production and processing of sugarbeets, the economic importance of this industry may not be fully realized. This report will provide an indication of the significant economic contribution the industry makes to the two-state area.

The authors wish to express their appreciation to the executives of the three sugarbeet processing cooperatives for their efforts to assemble data required for this analysis. Without the work of Mr. Robert Vivatson and Mr. Alvin Hansen this research project could not have been completed. Their effort, along with numerous other industry representatives, was critical to establishing a mutually agreeable method for collection of confidential data from firms in a very sensitive and competitive industry. Numerous colleagues at North Dakota State University and sugarbeet industry representatives are thanked for their reviews of this manuscript. The authors would also like to acknowledge Marna Unterseher for typing this report and Ms. Brenda Ekstrom for preparing the figure, and various faculty members of the Department of Agricultural Economics for their reviews and suggestions.

As always, our gratefulness to these individuals does not implicate them for any remaining errors or omissions.

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Highlights

The sugarbeet industry of eastern North Dakota and Minnesota is concentrated in a rather small area, and acres planted for sugarbeets constitute a small acreage when compared with major crops of the respective states. As a result of this, the industry's contribution to the economies in the two-state area are sometimes overlooked or underestimated. The sugarbeet industry is capital intensive and includes farm production and processing factories.

An expenditures-side approach was used to estimate the economic contribution by the industry. Cash expenditures in the two-state area were obtained from a combination of secondary data and a survey. Budgets were used to estimate farmer expenditures associated with the production of sugarbeets, and the processing cooperatives were surveyed to obtain the expenditures required to process the sugarbeets. These expenditures were applied to an input-output model to estimate key economic outcomes.

Expenditures in North Dakota and Minnesota resulting from the production and processing of sugarbeets amounted to nearly $345 million in 1987. These expenditures generated personal income of over $314 million, accounted for over $284 million in retail trade activity, and generated a total level of business activity of about $986 million for 1987. The level of personal income is not industry profit, but rather the economy-wide personal income resulting from the industry's expenditures and the multiplier effect upon them. Retail purchases required for the production and processing of sugarbeets have a strong influence on the retail sales level in the two-state area. The total level of business activity resulting from the industry's expenditures indicate the total amount of economic activity generated in the area during 1987. These economic contribution analyses results present in absolute terms an indication of the importance of the sugarbeet industry to the economy of the two-state area. Relating these key economic measures to the coal industry (i.e., coal mining and conversion) of western North Dakota may help put these numbers in perspective. Total business activity generated in the two-state area by the sugarbeet industry is slightly larger than that generated by the North Dakota lignite industry in 1987.

Other benefits resulting from the sugarbeet industry include 2,175 jobs for workers at the seven processing plants with many of these jobs being located in rural areas of North Dakota and Minnesota. Sugarbeet industry expenditures also are responsible for creating secondary (indirect and induced) employment. Secondary employment includes those jobs that arise to serve and support the industry and were estimated at 14,898 jobs for 1987. In addition, estimated state and local tax revenues amounted to over $27 million in 1987 because of activities associated with the sugarbeet industry. The multiplier effect is very evident for the sugarbeet industry where every dollar spent generates another $1.86 giving a total of $2.86.

The sugarbeet industry is a very important factor in the economies of North Dakota and Minnesota. The magnitude of key economic measures clearly indicates that the sugarbeet industry makes a significant contribution to the economies of these two states. Dollars added to an economic unit by an industry, such as the sweetener industry, can provide the impetus for economic growth as reflected in the levels of personal income, retail trade, and total business activity, and in addition provide secondary benefits including tax collections and employment.

THE ECONOMIC CONTRIBUTION OF THE SUGARBEET INDUSTRY OF EASTERN NORTH DAKOTA AND MINNESOTA

Randal C. Coon and F. Larry Leistritz*

Introduction

Eastern North Dakota and Minnesota have become one of the major sugar-producing areas in the United States. The industry in this area not only involves the production of the sugarbeets by farmers, but also includes the processing of the sugarbeets into packaged sweeteners ready for sale to consumer outlets. Processing agricultural products is one of the types of manufacturing that has succeeded in this area; in fact, most manufacturing firms operating in the area either process farm products or make farm equipment. (For a discussion of the manufacturing workforce, see Coon et al. 1987.)

Because sugarbeets are grown by a relatively small number of farmers compared to the number who grow wheat, the crop is often viewed as being a minor one. However, about 450,000 acres of sugarbeets are grown for three cooperatives (American Crystal Sugar Company, Minn-Dak Farmers Coop, and Southern Minnesota Beet Sugar Cooperative) and processed at seven factories. A combination of farm production and the factory processing of sugarbeets has produced many economic opportunities for persons in the sugarbeet-growing area.

The sugarbeet industry has made significant additions to the economies of North Dakota and Minnesota despite the fact that sugarbeet acreage is small compared to the major crops of the respective states. Because the industry tends to be concentrated in a small area when compared to the major crops, the industry's contribution to the economies of the respective states is often overlooked. However, the industry is capital intensive, includes farm production and processing factories, and makes a substantial economic contribution to the two-state area.

Purpose of the Study

The purpose of this study was to estimate the economic contribution the sugarbeet industry made to North Dakota and Minnesota in 1987. Such a study involves measuring, in terms of economic variables, the effects that all expenditures made by the industry have had on the economic unit (in this case, the states of North Dakota and Minnesota collectively). This analysis included expenditures by farmers for sugarbeet production, expenditures for research activities, and outlays by the seven processing factories.

Input-output analysis was used to analyze the contribution of the sugarbeet industry for the two states collectively. The direct effects of the sugarbeet industry include additional employment and income for residents in that area. Expenditures by the industry are recirculated within the local economy in the form of purchases of goods and services, tax

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revenues to the state government, and wages and salaries to households. These expenditures result in indirect and induced effects because of subsequent rounds of respending. Secondary impacts include increased employment and income.

Determining the economic contribution of a given industry provides detailed information regarding its importance to a local economy. In the case of the sugarbeet industry, this type of analysis is appropriate because the industry is concentrated in a small geographic area. The importance of this industry in terms of employment, personal income, and tax revenues should not be underestimated because it is not widely distributed throughout North Dakota and Minnesota. This report will provide a detailed economic analysis of the benefits accruing to the local economies as a result of the sugarbeet industry of eastern North Dakota and Minnesota.

Eastern North Dakota and Minnesota Sugarbeet Industry

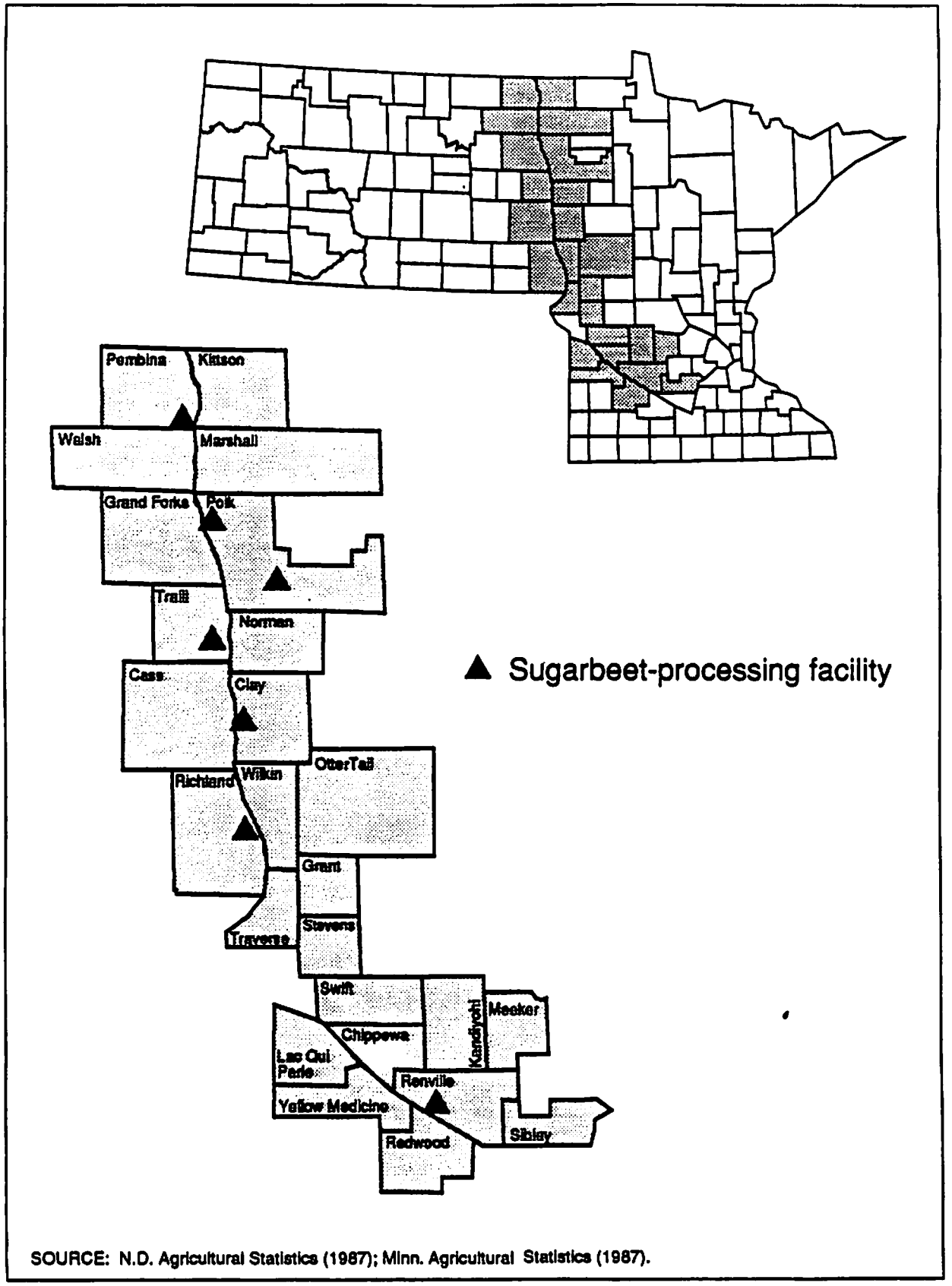
Sugarbeet production in the area is centered around the three producer-owned cooperatives. Shares of stock were sold, and each share entitles the holder to grow a specified number of acres of sugarbeets. Cooperatives include America Crystal Sugar Company with headquarters in Moorhead, Minnesota; Minn-Dak Farmers Coop located in Wahpeton, North Dakota; and Southern Minnesota Beet Sugar Cooperative in Renville, Minnesota.

Production of sugarbeets is located in the counties that are near the factories because of the relatively high transportation costs of the raw product. Counties in eastern North Dakota and Minnesota that produce sugarbeets for the American Crystal Sugar Company and Minn-Dak Farmers Coop include those bordering the Red River (Figure 1). Similarily, counties surrounding the Renville factory location (in west-central Minnesota) produce the sugarbeets for that cooperative.

Seven sugarbeet-processing factories are operating in North Dakota and Minnesota: Renville, Minnesota (Southern Minnesota Beet Sugar Cooperative); Wahpeton, North Dakota (Minn-Dak Farmers Coop); and Moorhead, Crookston, East Grand Forks, Minnesota, and Hillsboro and Drayton, North Dakota (American Crystal Sugar Company). Figure 1 also shows the location of the seven factories, which are located near the Red River stretching from near the North Dakota-South Dakota border to the North Dakota-Canadian border. These factories collectively process over 7 million tons of sugarbeets annually and provide jobs for over 2,000 full-time equivalents workers.

Methodology

Methodology for this study will be described in detail because it was not feasible to obtain all local expenditures for the eastern North Dakota and Minnesota sugarbeet industry through survey techniques. As a result, a combination of primary data collection and secondary sources was used to estimate the local expenditures for the industry. Local expenditures are defined as cash expenditures made by farmers for the factors required for



SOURCE: N.D. Agricultural Statistics (1987); Minn. Agricultural Statistics (1987).

Figure 1. Counties producing sugarbeets with growers affiliated with the three sugar-processing cooperatives.

the production of sugarbeets and cash outlays by the factories to convert the sugarbeets into finished sweetener products. This analysis was conducted collectively for North Dakota and Minnesota, so the local expenditures included those made in either state.

Expenditures

Local production expenditures were based on preliminary 1987 sugarbeet cost-of-production studies (Johnson and Clow 1987). Detailed cost-of-production budget information for sugarbeets is presented in Appendix A. The total cost per acre for producing sugarbeets in eastern North Dakota and Minnesota was $467.16 according to the budget. However, some of these budgetary items are not cash outlays in the local economy. Management charge is not typically a local expenditures and land charge for either the purchase or renting of land could commonly be payments outside of the two-state area. Therefore, local expenditures associated with the production of sugarbeets included cash outlays in the two-state area for such items as seed, fertilizer, chemicals, etc. Local production expenditures amounted to $367.08 per acre for 1987 [i.e., $467.16 - ($32.58 + $67.50)].

Local expenditures were less than the total cost of production for sugarbeets as presented in the crop budget (Appendix A). The management charge of $32.58 per acre, which is a valid economic cost for budgetary purposes, in all likelihood is not going to be a cash outlay in the local economy and was excluded from the local outlays for the purposes of this analysis. Local expenditures for the land charge ($67.50 per acre) could be a local expenditure and then would be included in this analysis, but where these outlays were made was virtually impossible to estimate. Local expenditures for land was difficult to estimate because the land could be (1) owned by the farmer-operator, (2) rented from local landlords, (3) rented from absentee landowners, (4) financed by the farmer-purchaser through local institutions, or (5) financed farmer purchases through nonlocal institutions. The possibility exists that a rather small portion of the land sugarbeets are raised on is actually in the process of being purchased (i.e., it is likely that only a small percentage of total acres planted in sugarbeets is being purchased and financed locally). For these reasons, including the land charge with the local expenditures could potentially overstate the economic contribution in this analysis.

Local sugarbeet production expenditures were aggregated to correspond with the sectors of the input-output model used for the analysis (see appendix C, Table 1 for sector definitions). The input-output model will be discussed in detail later in this report. Per-acre local expenditures for sugarbeet production were $216.69 in the retail trade sector; $87.05 in the finance, insurance, and real estate sector; and, $63.34 to the household sector (i.e., expenditures in the household sector were for hired labor). These local outlays totaled $367.08 per acre. Applying the total acres of sugarbeets grown in 1987 (465,361) to the production expenditures yielded total industry production expenditures by economic sector for 1987 (Table 1).

Expenditures by the seven processing factories (including outlays for research activities) were obtained from a survey of the three cooperatives. Because of disclosure problems and the highly competitive and sensitive nature of sweetener industry data, the expenditure data were not collected by the Department of Agricultural Economics. An agreement with all concerned parties provided for data collection by an independent certified public accounting firm, which aggregated expenditure data for the three cooperatives to correspond with the economic sectors of the input-output model.

Because expenditures data were not available for 1987 for all the cooperatives, the three firms provided average expenditures for the 1984 to 1986 period. These three-year averages for the factories were aggregated and these data were provided to researchers in the Department of Agricultural Economics. (Appendix B contains a sample questionnaire used to obtain the processing plants' local expenditures.) These three-year averages were assumed to reflect the 1987 level of expenditures for the factories, and throughout the remainder of this report they will be referred to as 1987 expenditures to be consistent with the sugarbeet production costs.

TABLE 1. ESTIMATED LOCAL EXPENDITURES FOR THE PRODUCTION OF SUGARBEETS IN EASTERN NORTH DAKOTA AND MINNESOTA, BY ECONOMIC SECTOR, 1987

Sector	Expenditures
	—$000—
Retail trade	100,839
Finance, insurance, and real estate	40,510
Households	29,476
Total	170,825

Again, it should be pointed out that the three cooperatives comprising the sugarbeet-processing industry in this area essentially are separate legal entities and collection of data from such a small number of firms creates a data disclosure problem. Department of Agricultural Economics researchers wish to express thanks to the processing industry's personnel and to the grower's representatives who worked hard to arrive at a mutually satisfactory arrangement for collecting these confidential data and eliminating potential disclosure problems. Total processing expenditures for the three cooperatives amounted to $173,931,000 for 1987. These expenditures represent local (North Dakota or Minnesota) cash outlays for production of sweeteners, and do not include noncash outlays or expenditures outside of the two-state area.

Input-Output Model

Economic contribution analysis requires choosing a technique for estimating the indirect and induced effects of an industry or a new project on economic activity, employment, and income. The alternatives considered included the economic base approach, econometric estimation based on time-series or cross-sectional data, and input-output analysis. Input-output (I-O) analysis was selected as the economic assessment framework for the eastern North Dakota and Minnesota sugarbeet industry. The primary reasons were that, compared to the economic base approach, I-O provides considerably more detailed assessment estimates (i.e., business volume and employment by sector) and I-O allows the analyst to take explicit account of differences in wage rates and local input-purchasing patterns in evaluating the impacts of various development proposals (Lewis 1968; Richardson 1972). Econometric techniques were thought to be inappropriate for this application because data were of insufficient detail for such analyses (Glickman 1972).

Input-output analysis is a technique for tabulating and describing the linkages or interdependencies between various industrial groups within an economy. The economy considered may be the national economy or an economy as small as that of a multicounty area served by one of the state's major retail trade centers. Input-output models have previously been developed for the state and substate areas of North Dakota (Leistritz et al. 1982) and Minnesota (Coon, Vocke, and Leistritz 1984b). Because of the aggregation of expenditures, the separate input-output models for North Dakota and Minnesota could not be used. This was not a concern because of the similarity of the economies of west and west-central Minnesota with eastern North Dakota. The North Dakota model was selected for this analysis because it was recently updated (Coon and Leistritz 1987). A microcomputer version of the North Dakota input-output model (NDIO/EPM) was used to generate the contribution results for this analysis (Coon, Leistritz, and Hertsgaard 1988).

The North Dakota model has been used extensively to estimate the economic contributions of a wide range of industrial sectors including, for example, the lignite industry (Coon, Mittleider, and Leistritz 1983), the recreation industry (Mittleider and Leitch 1984), agriculture (Coon, Vocke, and Leistritz 1984a), and the potato industry (Coon, Leistritz, and Scott 1986). For a complete discussion of input-output theory and methodology, as well as a review of the North Dakota input-output model, see Coon et al. (1985).

Interdependence Coefficients

Input-output interdependence coefficients have previously been developed for North Dakota. These coefficients are commonly called multipliers because they measure the number of times a dollar of income "turns over" in the state. The multiplier effect results when each producing sector buys some fraction of its inputs from other sectors of the state's economy and these sectors, in turn, use some fraction of that income to buy some of their inputs from still other sectors, and so on. The multiplier effect is due to the spending and respending within the state's economy of part of each dollar that enters the state.

The North Dakota input-output model groups the state's economy into seventeen industrial classifications or sectors (Appendix C, Table 1). Input-output interdependence coefficients for North Dakota are presented in Appendix C, Table 2. Application of the local expenditures to the respective multipliers will yield levels of business activity necessary to measure the economic contribution of the sugarbeet industry. Because all local expenditures were in terms of 1987 current year prices, applying these values to the multipliers also yields economic assessments in similar terms.

Productivity Ratios

The ratio of gross business volume to employment is called the productivity ratio. This ratio indicates the amount of business activity in a sector per worker in that sector. Productivity ratios are particularly useful when conducting economic contribution studies. When in-state expenditures for a particular industry are applied to the multipliers, the resulting business activity can be divided by the productivity ratios to estimate secondary (or indirect and induced) employment. Secondary employment arises as a result of the expenditures from the industry as they are spent and respent throughout the economy by the multiplier process. This employment is in addition to the workers directly employed by the industry, and essentially comes into existence to serve and supply the industry.

Productivity ratios have been developed for North Dakota contribution analysis (Coon, Leistritz, and Hertsgaard 1988). These ratios were used to estimate secondary employment for this study. Productivity ratios used to estimate indirect and induced workers resulting from the sugarbeet industry expenditures in eastern North Dakota and Minnesota are presented in Appendix C, Table 3.

Tax Revenue Estimation

Several tax revenues can be estimated using the input-output model. These include state personal income tax, corporate income tax, and sales and use tax collections. Tax revenue estimates for each state have been determined based on historic relationships between tax collections and the input-output model estimates of gross business volume for selected sectors. Calculated tax rates were based on ratios in existence in 1983 for North Dakota (Coon et al. 1984) and 1982 for Minnesota (Coon, Vocke, and Leistritz 1984b). These estimates may be out-of-date because rapidly shifting financial conditions in both states have caused numerous tax law changes since 1982. Several year's tax collection data are required to update the estimating equations with a high degree of reliability, and these data were not available because of recent tax rate changes.

Another problem was that tax rate estimators were available for each state, but all expenditures were reported as totals for the two-state area. Tax rate estimators for the two states were averaged, and the assumption was that the expenditures would be equally distributed between the two states.

Adjustments were made to the sales and use tax estimator to reflect 1987 tax collection laws.

Estimates of state personal income tax collections were based on historic relationships for each state and averaged. Although these rates have changed in the respective states, the allocators were not altered because sufficient data were not available upon which to make changes. Also, changes for these rates were not as significant as those for sales and use taxes. State personal income tax collection estimates were based on the following relationships:

State personal income tax collections = 2.8 percent x personal income

Personal income from the input-output model is the total business activity of the household sector. The state equations to estimate corporate income tax for the respective states were not changed because adequate data were not available upon which accurate revisions could be based. The state corporate income tax estimating equation is as follows:

State corporate income tax = .31 percent x total business activity of all business sectors

All business sectors consist of all sectors of the economy except for the agriculture, household, and government sectors. State sales and use taxes, typically the state's major source of tax revenue, had the most significant rate increases. Both North Dakota and Minnesota had lower sales tax rates on farm machinery and equipment purchases than on ordinary retail sales. To estimate sales tax revenue on farm machinery purchases, direct machinery purchase amounts from the budgets were applied to an average of the North Dakota (3.5%) and Minnesota (2%) sales tax rate (i.e., a 2.75% rate). Many farm production expenses (e.g., seed, fertilizer) are not subject to sales tax in either state. To compensate for these nontaxable retail purchases, the direct farm production retail purchases (including machinery, which was taxed at a lower rate) were deducted from the retail trade activity generated by the input-output model. State sales and use tax collections were estimated based on the following relationship:

State sales and use tax = 5.75 percent x (retail trade activity - direct farm production retail purchases)

Retail trade activity is the total business activity of the retail trade sector of the input-output model. Applying this tax estimating equation to the business activity generated from the local expenditures provides tax revenue estimates for the three major taxes for North Dakota and Minnesota collectively.

Model Validation

The accuracy of the input-output model has been tested by comparing personal income from the model (gross business volume of the household sector is, by definition, personal income) with personal income reported by the Bureau of Economic Analysis, U.S. Department of Commerce. For the period 1958 to 1984, estimates of North Dakota personal income from the input-output model had an average deviation of 5.47 percent from Department of Commerce estimates (Table 2). The Theil coefficient indicates this variability does not preclude the use of the model for predictive purposes. In fact, the closeness of the Theil coefficient values to 0.0 indicates that the model performs quite well and can be used with confidence. The Theil U_1 coefficient is a summary measure, whose value is bounded by 0 and 1. A value of 0 indicates perfect prediction, while a value of 1 corresponds to perfect inequality (i.e., between the actual and predicted values). (For further discussion of the Theil coefficient, see Leuthold [1975] and Pindyck and Rubinfeld [1981].)

TABLE 2. COMPARISON OF STATISTICAL TESTS FOR THE INPUT-OUTPUT MODEL PERSONAL INCOME ESTIMATION, NORTH DAKOTA, 1958-1984

Statistical Test	Result
Average Absolute Difference[a]	5.47
Mean Difference[b]	-1.88
Standard Deviation[c]	6.27
Theil Coefficient[d]	0.07

[a]Average absolute difference is the sum of the absolute values of the percentage difference of I-O estimates and U.S. Department of Commerce estimates in each year divided by the number of years.
[b]Mean difference is the sum of the percentage difference of the I-O estimate and U.S. Department of Commerce estimates for each year divided by the number of years.
[c]Standard deviation is for the difference of the I-O estimate and U.S. Department of Commerce estimates.
[d]Theil's coefficient is calculated using the formula:

$$U_1 = \frac{\sqrt{\frac{1}{T}\ \Sigma(Ys - Ya)^2}}{\sqrt{\frac{1}{T}\ \Sigma(Ys)^2}\ \sqrt{\frac{1}{T}\ \Sigma(Ya)^2}}$$

where: T = time period
Ys = input-output value of Y (personal income)
Ya = U.S. Department of Commerce value of Y (personal income)

Economic Contribution

The economic contribution of the sugarbeet industry on the collective economies of North Dakota and Minnesota was analyzed. Estimates of the industry's local expenditures provide the basis for estimates of business activity, personal income, retail sales, secondary employment, and selected tax revenue collections. Results will be reported for the industry as previously defined and including production and processing for 1987. Results will be presented for the local economy as the sum of North Dakota and Minnesota because of the way data were collected to avoid disclosure problems.

Expenditures and Total Business Activity

Total sugarbeet industry expenditures in the two-state area totaled about $345 million in 1987 (Table 3). This total includes only cash outlays, and is the sum of expenditures for the production and processing operations. The largest amount of expenditures are to the retail trade sector because the farm production of sugarbeets requires large outlays for seed, fertilizer, machinery, etc. Processing-phase expenditures include large amounts for transportation and payments to the household sector. Payments to the household sector are primarily for the wages and salaries to the work force required to operate the processing factories.

TABLE 3. ESTIMATED EASTERN NORTH DAKOTA AND MINNESOTA SUGARBEET PRODUCTION AND PROCESSING LOCAL EXPENDITURES BY ECONOMIC SECTOR, 1987

Sector	Local Expenditures
	-----$000-----
Construction	24,713
Transportation	54,673
Communications and public utilities	8,772
Agricultural processing and miscellaneous manufacturing	6,682
Retail trade	104,343
Finance, insurance, and real estate	64,789
Business and personal services	292
Professional and social services	442
Households	78,936
Coal mining	1,114
Total	344,756

This economic contribution study employed an expenditures-side approach to estimate the added economic activity attributable to the sugarbeet industry. Expenditures made in the local (or in this case, the two-state) economy will be spent and respent as a result of the multiplier process and generate higher levels of business activity. Key measures of economic activity include personal income, retail trade sales, and the total level of business activity. Levels of economic activity for these key measures are presented in Table 4.

As the result of sugarbeet industry's expenditures, an estimated personal income of over $314 million was generated in 1987. It is important to emphasize that this level of personal income is not profit to the industry but rather economy-wide personal income resulting from the industry's expenditures and the multiplier effect upon them. Estimated retail trade activity was over $284 million; retail purchases required for the production of sugarbeets have a strong influence on the high level of retail activity within the two-state area. The total level of business activity resulting from the industry's expenditures—or expressed in more easily understandable terms, the number of times the cash register rings—amounted to an estimated $985.7 million in 1987. If the total business activity ($985.7 million) is divided by the total local expenditures ($344.8 million), the overall multiplier for the sugarbeet industry is 2.86. This means that for every dollars of local expenditures made by the sugarbeet industry, another $1.86 is created giving a total of $2.86.

The magnitude of these key economic measures clearly indicates that the sugarbeet industry makes a significant contribution to the economies of these two states. Dollars added to an economic unit by an industry, such as the sweetener industry, can provide the impetus for economic growth as reflected in the levels of personal income, retail trade, and total business activity, and in addition provide secondary benefits including tax collections and employment.

TABLE 4. ESTIMATED PERSONAL INCOME, RETAIL SALES, BUSINESS ACTIVITY OF ALL BUSINESS (NONAGRICULTURAL) SECTORS, AND TOTAL BUSINESS ACTIVITY RESULTING FROM EASTERN NORTH DAKOTA AND MINNESOTA SUGARBEET PRODUCTION AND PROCESSING, 1987

Item	Amount
	-$000-
Personal income	314,243
Retail sales	284,287
Business activity of all business sectors[a]	597,733
Total business activity	985,709

[a]Includes all sectors except agriculture (livestock and crops), households, and government.

Tax Collections

Data in Table 4 provided the necessary measures of business activity to estimate tax revenues generated by the sugarbeet industry. Categories of tax revenues consisted of sales and use, personal income, corporate income, and other taxes. Estimated tax revenues associated with the economic contribution of the sugarbeet industry totaled over $27 million in the two-state area of North Dakota and Minnesota (Table 5). It should be noted that farm real estate taxes are not included in Table 5. Previously mentioned difficulties encountered when trying to determine land charge (ownership) also made it virtually impossible to estimate farm real estate tax payments attributable to sugarbeet acres.

These estimated tax collections are the total for the two-state area and were determined using average rates for the states, which assumes that there is an equal distribution of expenditures in each state. Estimating equations may be slightly out-of-date, but data to accurately update the equations were not available. The largest source of tax revenue was the sales and use tax category reflecting the major source of state revenue and the large amount of retail activity resulting from sugarbeet industry expenditures.

Employment

The sugarbeet industry also benefits the economy by providing employment opportunities. It is difficult to estimate exactly how many jobs are created by the production of sugarbeets because all of the farmers also raise other crops. Approximately 2,400 farmers are involved in sugarbeet production along with a large number of hired workers. It is virtually impossible to obtain a total number for the employment in sugarbeet production and equally as difficult to convert to full-time equivalents. The sugarbeet industry also creates seasonal employment opportunities for migrant workers and truck drivers. During June and July, sugarbeet producers provide employment opportunities for migrant workers with jobs for an estimated 5,000 to 6,000 workers in 1987 (Fitzsimons 1988). In addition, during the harvest period part-time truck driving jobs are available for a minimum of 5,800 workers. These jobs are reflected in the full-time equivalents secondary jobs discussed later in this report.

Employment at the seven sugarbeet processing factories was obtained along with the expenditures data on the questionnaire to the cooperatives. Full-time-equivalent employment at the seven factories totaled 2,175 workers in 1987. A significant benefit of the sugarbeet processing industry's employment is that the factories, and therefore the jobs, are located in rural areas such as Drayton and Hillsboro. The industry is unique in this respect because most manufacturing or processing facilities are located near urban centers because of transportation, material requirements, etc.

Sugarbeet industry expenditures also were responsible for creating secondary (indirect and induced) employment. Secondary employment associated with the industry was estimated by using productivity ratios previously determined and the levels of business activity generated as the result of the sugarbeet industry's expenditures. Secondary employment does not include the workers employed directly by the industry, but rather jobs

TABLE 5. ESTIMATED TAX REVENUES ASSOCIATED WITH EASTERN NORTH DAKOTA AND MINNESOTA SUGARBEET PRODUCTION AND PROCESSING, 1987

Tax	Revenue
	—$000—
Sales and use	11,252
State personal income	8,799
State corporate income	1,853
Other[a]	5,513
Total[b]	27,417

[a]Other includes property taxes, workman's compensation, unemployment, and miscellaneous taxes paid by the processing factories.
[b]Does not include farm real estate tax revenues for sugarbeet acreage.

that arise to serve and support the industry. Indirect and induced employment resulting from sugarbeet industry expenditures was estimated at 14,898 full-time equivalent jobs for 1987. Seasonal peak employment resulting from the sugarbeet industry would be considerably higher than the full-time equivalent estimates because of the large number of migrant workers and truck drivers employed for very short periods.

Conclusions

The sugarbeet industry is concentrated in a rather small portion of the two-state area. Despite the relatively small geographic area in which its production and processing take place, the sugarbeet industry is very capital intensive. It is one of the few industries in the North Dakota-Minnesota area that processes a raw product and packages it for sales to final consumers. In the eastern North Dakota and Minnesota area the only industries providing this type of economic opportunity have been associated with the agricultural sector. Local expenditures by the industry have provided an economic lift to the area. However, because the production area is not widespread, the economic contribution of the industry may be underestimated or even overlooked by many people.

The sugarbeet industry does contribute significantly to the economies of North Dakota and Minnesota. Estimated local expenditures amounted to over $344 million in 1987. These expenditures generated personal income of over $314 million, retail trade activity over $284 million, and a total level of business activity of nearly $986 million in 1987. Results of these economic contribution analyses present in absolute terms an indication of the importance of the sugarbeet industry to the economy of the two-state area. Relating these key economic measures to the coal industry (i.e., coal mining and conversion) of western North Dakota may help put these numbers in perspective. The total business activity generated in the two-state area by the sugarbeet industry is slightly larger than that generated by the North Dakota lignite industry in 1987 (Coon and Leistritz 1988). It also would be

helpful if these results could be compared to the economic base of the local economy for each state. This would help put the industry's importance in perspective; however, data are not readily available for a substate comparison. (For a complete discussion of the economic base of North Dakota and its planning areas, see Coon et al. [1986].)

Estimated tax revenue collections totaled over $27 million in 1987 as a result of the sugarbeet industry's activities. In addition to those workers directly employed by the industry, secondary jobs were created for an estimated 14,898 full-time equivalent workers based on economic contribution expenditures.

Each dollar spent by the sugarbeet industry creates another $1.86 in the local economy. The sugarbeet industry is a very important factor in the economies of North Dakota and Minnesota. Its economic contribution is sizeable when measured in such economic terms as personal income, retail sales, total business activity, tax revenue collections, and employment (direct and secondary). These key economic variables provide an indication of the importance of the sugarbeet industry to the two-state area.

Appendix A

Sugarbeet Production Costs Budget

TABLE A1. PRODUCTION COSTS PER PLANTED ACRE FOR SUGARBEETS GROWN IN EASTERN NORTH DAKOTA AND MINNESOTA, 1987

Item	Unit	Price	Quantity	Value
Variable costs				
Beet seed				$ 28.20
Nitrogen	Lbs.	0.157	60.30	9.47
Phosphate	Lbs.	0.181	59.70	10.81
Potash	Lbs.	0.077	42.20	3.25
Custom fert. application	Acre	3.07	0.50	1.54
Insecticide	Acre	10.26	0.84	8.58
Preplant incorporated and preemergence herbicide	Acre	17.89	0.45	7.98
Postemergence herbicide	Acre	8.80	2.36	20.75
Fungicide	Acre	5.53	0.95	5.26
Custom pesticide application	Acre	3.27	1.20	3.92
Hand thinning	Acre	33.00	0.22	7.26
Hand weeding	Acre	22.00	0.70	15.40
Migrant housing				3.78
Hired machine labor	Hour	5.63	2.51	14.13
Unpaid machine labor	Hour	5.63	2.50	14.08
Social security and workmen's comp				4.62
Custom hauling				4.07
Fuel and lube				28.71
Repairs				18.71
Crop insurance				3.35
Miscellaneous[a]				5.50
Interest on operating capital	$	0.111	100.92	11.20
Total variable costs				$230.57
Fixed costs				
Machinery replacement				$ 55.01
Interest on machinery investment	$	0.07	445.77	31.20
Farm overhead[b]				9.00
Co-op share[c]	$	0.07	590.00	41.30
Management charge (10% of cost except land and co-op investment)				32.58
Land charge				67.50
Total fixed costs				$236.59
TOTAL COSTS				$467.16

[a]Includes soil sampling, crop monitoring, beet hoes, interest and depreciation on unused beet equipment, machine rent, other custom work, and micronutrients.
[b]Includes insurance, utilities, vehicle license and tax, bookkeeping, and other items.
[c]Share price divided by 1.1 to convert to an acre of sugarbeet.

SOURCE: Johnson and Clow (1987).

Appendix B

Questionnaire Used to Obtain Local Expenditures By Sugarbeet-Processing Factories

INSTRUCTIONS

This questionnaire is designed to help you provide us with information on your expenditures in North Dakota and Minnesota. Data provided from this survey will be used to help estimate the contribution the sugarbeet industry makes to the economies of North Dakota and Minnesota. All information will be kept strictly confidential. The following general instructions are suggested in completing the questionnaire.

1. Use your records from the most recently completed fiscal year.
2. Information should be recorded in dollar terms.
3. If the cooperative you process for operates more than one establishment, it is preferred that you include only the expenditures from your establishment on this questionnaire. Each factory will be sent a questionnaire to complete. If common costs exist, they should be included on only one of the questionnaires.
4. If you cannot identify whether expenditures were made to North Dakota or Minnesota entities, please indicate so on the form.
5. When exact information is not available, please estimate.
6. Definitions for selected expenditure items and their corresponding Standard Industrial Classification (SIC) code listing are included to help in determining allocation of expenditures.
7. If you have questions, please contact:

Randy Coon (701) 237-7451
or
Larry Leistritz (701) 237-7455

Department of Agricultural Economics
North Dakota State University
P.O. Box 5636
Fargo, ND 58105

SUGARBEET PROCESSOR EXPENDITURES SURVEY

Cooperative: _____

Location: _____

I. Expenditures (_____ year)

Items for Which Expenditures are Made	Estimated Annual Expenditure In North Dakota	Minnesota
	----------dollars----------	
Payments to sugarbeet growers		
Contract construction		
Plant maintenance and overhaul		
Transportation		
Communications		
Public utilities		
Miscellaneous manufacturing		
Wholesale trade		
Retail trade		
Finance, insurance, and real estate		
Business and personal services		
Professional and social services		
Coal		
Electricity		
Petroleum/natural gas		
Wages and salaries		
Benefits		
Sugarbeet research funded		
Government (taxes paid in ND and MN only)		
Property		
Sales and use		
Workman's compensation		
Unemployment		
Other taxes (please specify)		
Other (please specify)		

II. Total annual revenue $_____

III. Number of workers in full-time equivalents: _____ workers

IV. Sugarbeets processed: _____ tons

DEFINITIONS FOR EXPENDITURE ITEMS
(According to the Standard Industrial Classification Manual)

Construction
Includes building construction--general contractors engaged in construction of residential, farm, industrial, public, and other buildings. (Major Groups 15, 16, and 17)

Transportation
Includes railroad, motor freight, water transportation, air transportation, pipeline transportation of petroleum, and other transportation to include packing and crating services, and rental of transportation equipment. (Major Groups 40, 41, 42, 43, 44, 45, 46, and 47)

Communications
Includes establishments engaged in telephone, telegraph, radio, television, and other communication services. (Major Group 48)

Public Utilities

Includes natural gas companies engaged in the transmission, storage, or distribution of natural gas. Also, water supply and sanitary services are included. (Major Group 49 except Group 491)

Wholesale Trade
Includes establishments primarily engaged in selling merchandise to retailers; to industrial, commercial, institutional, or professional users; or to other wholesalers, or acting as agents in buying merchandise for or selling merchandise to such persons or companies. (Major Groups 50 and 51)

Retail Trade
Include establishments engaged in selling merchandise for personal, household, or farm consumption, and rendering services incidental to the sale of goods. (Major Groups 52, 53, 54, 55, 56, 57, 58, and 59)

Finance, Insurance, and Real Estate
Includes institutions engaged in banking, or other financial institutions, insurance, and real estate. (Major Groups 60, 61, 62, 63, 64, 65, 66, and 67)

Business and Personal Services
Includes firms operating lodging services, repair, laundry, entertainment, other personal services predominantly to private individuals, credit collectional, janitorial, and stenographic services. (Major Groups 70, 72, 73, 75, 76, 78, and 79)

Professional and Social Services
Includes establishments engaged in furnishing health, medical, legal, educational, research and development, and other professional services. (Major Groups 80, 81, 82, 83, 84, 86, 88, and 89)

Appendix C

Input-Output Tables

TABLE C1. ECONOMIC SECTORS AND ASSOCIATED STANDARD INDUSTRIAL CLASSIFICATION CODES FOR THE NORTH DAKOTA INPUT-OUPUT MODEL

Economic Sector	SIC Code
1. Agriculture, Livestock	Major Group 02 - Agricultural Production, Livestock
2. Agriculture, Crops	Major Group 01 - Agricultural Production, Crops
3. Nonmetallic Mining	Major Group 14 - Mining and Quarrying of Nonmetallic Minerals, Except Fuels
4. Contract Construction	Major Groups 15, 16, 17 - Contract Construction
5. Transportation	Major Groups 40, 41, 42, 43, 44, 45, 46, and 47 - Transportation
6. Communications and Utilities	Major Group 48 - Communication, and Major Group 49 - Electric, Gas, and Sanitary Services, Except Industry No. 4911
7. Agricultural Processing and Miscellaneous Manufacturing	Major Group 50 and 51 - Wholesale Trade, Major Group 20 - Food and Kindred Products Manufacturing
8. Retail Trade	Major Groups 52, 53, 54, 55, 56, 57, 58, and 59 - Retail Trade
9. Finance, Insurance, and Real Estate	Major Groups 60, 61, 62, 63, 64, 65, 66, and 67 - Finance, and Insurance, and Real Estate
10. Business and Personal Services	Major Groups 70, 72, 73, 75, 76, 78, and 79 - Business and Personal Services
11. Professional and Social Services	Major Groups 80, 81, 82, 83, 84, 86, 88, and 89 - Professional and Social Services
12. Households	Not Applicable
13. Government	Major Groups 91, 92, 93, 94 , 95, 96, and 97 - Government
14. Coal Mining	Major Group 12 - Bituminous Coal and Lignite Mining
15. Thermal-Electric Generation	Major Group 491 - Electric Companies and Systems
16. Petroleum and Natural Gas Exploration and Extraction	Major Group 13 - Crude Petroleum and Natural Gas
17. Petroleum Refining	Major Group 29 - Petroleum Refining and Related Industries

SOURCE: Office of Mangement and Budget (1972).

TABLE C2. INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS, BASED ON TECHNICAL COEFFICIENTS FOR 17-SECTOR MODEL FOR NORTH DAKOTA

Sector	(1) Ag, Lvstk	(2) Ag, Crops	(3) Nonmetallic Mining	(4) Const	(5) Trans	(6) Comm & Pub Util	(7) Ag Proc & Misc Mfg	(8) Retail Trade	(9) FIRE
(1) Ag, Livestock	1.2072	0.0774	0.0445	0.0343	0.0455	0.0379	0.1911	0.0889	0.0617
(2) Ag, Crops	0.3938	1.0921	0.0174	0.0134	0.0178	0.0151	0.6488	0.0317	0.0368
(3) Nonmetallic Mining	0.0083	0.0068	1.0395	0.0302	0.0092	0.0043	0.0063	0.0024	0.0049
(4) Construction	0.0722	0.0794	0.0521	1.0501	0.0496	0.0653	0.0618	0.0347	0.0740
(5) Transportation	0.0151	0.0113	0.0284	0.0105	1.0079	0.0135	0.0128	0.0104	0.0120
(6) Comm & Public Util	0.0921	0.0836	0.1556	0.0604	0.0839	1.1006	0.0766	0.0529	0.1321
(7) Ag Proc & Misc Mfg	0.5730	0.1612	0.0272	0.0207	0.0277	0.0239	1.7401	0.0452	0.0704
(8) Retail Trade	0.7071	0.8130	0.5232	0.4100	0.5475	0.4317	0.6113	1.2734	0.6764
(9) Fin, Ins, Real Estate	0.1526	0.1677	0.1139	0.0837	0.1204	0.1128	0.1322	0.0577	1.1424
(10) Bus & Pers Services	0.0562	0.0684	0.0430	0.0287	0.0461	0.0374	0.0514	0.0194	0.0766
(11) Prof & Soc Services	0.0710	0.0643	0.0559	0.0402	0.0519	0.0526	0.0530	0.0276	0.0816
(12) Households	1.0458	0.9642	0.8424	0.6089	0.7876	0.7951	0.7859	0.4034	1.2018
(13) Government	0.0987	0.0957	0.0853	0.0519	0.2583	0.0999	0.0796	0.0394	0.1071
(14) Coal Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(15) Thermal-Elec Generation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(16) Pet Exp/Ext	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(17) Pet Refining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gross Receipts Multiplier	4.4931	3.6851	3.0284	2.4430	3.0534	2.7901	4.4509	2.0871	3.6778

- continued -

TABLE C2. INPUT OUTPUT INTERDEPENDENCE COEFFICIENTS, BASED ON TECHNICAL COEFFICIENTS FOR 17-SECTOR MODEL FOR NORTH DAKOTA (CONTINUED)

Sector	(10) Bus & Pers Service	(11) Prof & Soc Service	(12) Households	(13) Govt	(14) Coal Mining	(15) Thermal-Elec Generation	(16) Pet Exp/Ext	(17) Pet Refining
(1) Ag, Livestock	0.0384	0.0571	0.0674	0.0000	0.0376	0.0251	0.0159	0.0145
(2) Ag, Crops	0.0152	0.0229	0.0266	0.0000	0.0285	0.0321	0.0062	0.0057
(3) Nonmetallic Mining	0.0043	0.0050	0.0057	0.0000	0.0032	0.0019	0.0045	0.0037
(4) Construction	0.0546	0.0787	0.0902	0.0000	0.0526	0.0328	0.1148	0.0929
(5) Transportation	0.0118	0.0100	0.0093	0.0000	0.0084	0.0048	0.0180	0.0172
(6) Comm & Public Util	0.1104	0.1192	0.1055	0.0000	0.0712	0.0378	0.0510	0.0444
(7) Ag Proc & Misc Mfg	0.0237	0.0362	0.0417	0.0000	0.0618	0.0782	0.0097	0.0089
(8) Retail Trade	0.4525	0.6668	0.7447	0.0000	0.3995	0.2266	0.1838	0.1675
(9) Fin, Ins, Real Estate	0.1084	0.1401	0.1681	0.0000	0.0771	0.0977	0.0388	0.0358
(10) Bus & Pers Services	1.0509	0.0455	0.0605	0.0000	0.0289	0.0201	0.0139	0.0127
(11) Prof & Soc Services	0.0497	1.1026	0.0982	0.0000	0.0493	0.0301	0.0210	0.0195
(12) Households	0.7160	1.0437	1.5524	0.0000	0.6666	0.3973	0.3205	0.2951
(13) Government	0.0774	0.0881	0.1080	1.0000	0.0511	0.0444	0.0280	0.0285
(14) Coal Mining	0.0000	0.0000	0.0000	0.0000	1.0000	0.1582	0.0003	0.0002
(15) Thermal-Elec Generation	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000
(16) Pet Exp/Ext	0.0000	0.0000	0.0000	0.0000	0.0138	0.0084	1.0981	0.8227
(17) Pet Refining	0.0000	0.0000	0.0000	0.0000	0.0168	0.0102	0.0000	1.0000
Gross Receipts Multiplier	2.7133	3.4159	3.0783	1.0000	2.5664	2.2057	1.9245	2.5693

TABLE C3. PROJECTED GROSS BUSINESS VOLUME TO EMPLOYMENT (PRODUCTIVITY) RATIOS USED IN THE NORTH DAKOTA INPUT-OUTPUT ECONOMIC PROJECTION MODEL, BY ECONOMIC SECTOR, NORTH DAKOTA, (1986=BASE DOLLARS), 1986-2000

Year	(1) & (2) Agriculture	(3) Nonmetallic Mining	(4) Const	(5) Trans	(6) Comm & Pub Util	(7) Ag Proc & Misc Mfg	(8) Retail Trade	(9) FIRE	(10) Bus & Pers Service	(11) Prof & Soc Service	(12) House-holds	(13) Govt	(14) Coal Mining	(15) Thermal-Electric Generation	(16) Pet Exp/Ext	(17) Pet Refining
1986	121,450	308,730	44,367	14,242	81,027	71,901	103,963	114,131	17,712	15,956	--	12,562	103,227	405,305	177,627	556,565
1987	124,633	311,743	44,924	14,516	82,428	72,118	105,010	114,442	17,674	15,905	--	12,660	107,047	421,577	181,796	575,587
1988	127,816	314,756	45,482	14,789	83,829	72,336	106,057	114,753	17,636	15,854	--	12,759	110,868	437,850	185,964	594,609
1989	131,000	317,768	46,039	15,063	85,230	72,553	107,105	115,064	17,599	15,803	--	12,857	114,688	454,122	190,132	613,631
1990	134,183	320,078	46,596	15,336	86,630	72,771	108,152	115,376	17,561	15,752	--	12,995	118,508	470,394	194,301	632,653
1991	137,366	323,794	47,154	15,609	88,031	72,988	109,200	115,687	17,523	15,701	--	13,054	122,328	486,666	198,469	651,674
1992	140,550	326,806	47,711	15,883	89,432	73,206	110,247	115,998	17,486	15,650	--	13,152	126,149	502,938	202,637	670,696
1993	143,733	329,819	48,268	16,156	90,833	73,423	111,294	116,309	17,448	15,599	--	13,250	129,969	519,211	206,806	689,718
1994	146,917	332,832	48,826	16,429	92,234	73,640	112,342	116,620	17,411	15,548	--	13,348	133,789	535,483	210,974	708,740
1995	150,100	335,845	49,383	16,703	93,635	73,858	113,389	116,932	17,373	15,497	--	13,447	137,610	551,755	215,142	727,761
1996	153,283	338,857	49,940	16,976	95,036	74,075	114,438	117,243	17,335	15,446	--	13,545	141,430	568,027	219,311	746,783
1997	156,467	341,870	50,498	17,250	96,437	74,293	115,484	117,554	17,298	15,395	--	13,643	145,250	584,299	223,479	765,805
1998	159,650	344,883	51,055	17,523	97,838	74,510	116,532	117,865	17,260	15,344	--	13,742	149,071	600,572	227,647	784,827
1999	162,833	347,896	51,612	17,796	99,239	74,728	117,579	118,176	17,222	15,293	--	13,840	152,891	616,844	231,816	803,848
2000	166,017	350,908	52,170	18,070	100,640	74,945	118,626	118,488	17,185	15,242	--	13,938	156,711	633,116	235,984	822,870

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