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The North Dakota Construction Industry's Contribution to the State Economy

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Highlights

The North Dakota construction industry has an important role in the growth of the state's economy. In addition to the roads, streets, buildings, and municipal projects that are built by this industry and necessary for economic and population growth within the state, the construction industry benefits the economy by making a significant amount of local expenditures. The economic contribution this industry makes to the state has been determined for the entire industry as well as for three subdivisions--road, building, and municipal/heavy construction.

Estimated 1985 in-state expenditures for the entire industry and each subdivision were obtained through a combination of a mail survey, a telephone survey, and secondary data. Those expenditures were applied to the North Dakota input-output model to estimate the economic contribution the industry makes to the state in terms of key economic variables. Estimated local expenditures for the industry totaled over $274 million for 1985 with road construction accounting for 56 percent ($154 million) followed by building construction ($91 million) and municipal/heavy construction ($29 million).

As a result of the local expenditures, the entire industry generated estimated retail trade activity of $194 million, personal income of $234 million, and total business activity amounting to $780 million. The road construction industry subdivision generated personal income, retail trade activity, and total business activity of $131 million, $119 million, and $428 million, respectively. Building subdivision expenditures resulted in retail trade activity of $73 million, personal income of $52 million, and total business activity of $256 million. Total business activity attributable to the municipal/heavy subdivision was estimated to be $96 million with retail trade activity of $30 million and personal income of $23 million. Tax revenues associated with the industrywide levels of business activity were estimated to be $14.3 million for 1985. In addition to the industry direct workforce (3,614 full-time equivalent workers), another 13,048 indirect and induced jobs were created as a result of construction industry expenditures.

Because of the multiplier process, whereby a dollar injected into the economy "turns over" and creates additional "new" dollars, an additional $1.81 of business activity is created for each original dollar of construction industry expenditures. Thus, each original dollar injected into the economy plus the created $1.81 yielded a total of $2.81 in total business activity.

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Introduction

North Dakota's construction industry serves the state's residents in many ways. This industry provides the physical means for economic and population growth in the state. Construction and maintenance of the highway system is important because it provides a way for the state's income-producing activities to reach markets and a means by which goods and services can be obtained on a day-to-day basis. Construction of buildings and municipal projects (i.e., streets, water facilities, sewer, etc.) provide the facilities that are necessary for people to work and live. Economic and population growth would be greatly restricted without the ability of the construction industry to meet the needs of the state's businesses, residents, and governmental organizations.

The large volume of expenditures associated with construction activities has led to the industry's becoming a very important component of the North Dakota economy. The economic contribution this industry makes to the state is estimated in this study for the entire industry as well as for three subdivisions--road, building, and municipal/heavy construction. Such a study involves measuring, in terms of economic variables, the effects that all expenditures made by the industry have on the economic unit (in this case, the state). Expenditures for construction are injected into the economy and, as a result of the multiplier process, higher levels of total business activity, retail trade activity, and personal income occur. Because of subsequent rounds of respending of the original expenditures, secondary impacts accrue within the state. Secondary impacts include indirect and induced employment and tax revenues.

Similar analysis has previously been performed for the road construction and maintenance industry as part of this research effort (Coon, Scott, and Leistritz 1986). Information presented in that study will be used in this analysis, but the assumptions and specifics presented in the earlier report will not be repeated. The contribution the construction industry makes to the state's economy will be estimated and presented for the entire industry and for three component divisions (road, building, and municipal/heavy construction). Measuring, in terms of economic variables, the construction industry's contribution to the economy of North Dakota provides an indication of the importance of the industry to the state's economy.

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Methodology

The economic contribution of the construction industry to the state's economy was analyzed using the North Dakota input-output model. In-state industry expenditures were obtained through a combination of a mail survey, a telephone survey, and secondary data. These expenditures were applied to the interdependence coefficients to estimate the associated levels of personal income, retail trade activity, and total business activity. Secondary impacts, such as indirect and induced employment and tax revenues, accrue to the state as a result of the multiplier process on the industry's local expenditures.

The construction industry's contribution to the state's economy will be reported for 1985 because firms involved in road construction and maintenance were surveyed in the fall of 1986 (before completion of their 1986 tax year). Because the survey was administered to the building and municipal/heavy construction firms at a later date, they were allowed the option of reporting their expenditures for 1985 or 1986. Most of the returned questionnaires were for 1985 so these expenditures also will be reported for 1985. All results are reported in terms of 1985 dollars and as accruing to the state rather than to particular regions.

Local Expenditures

A questionnaire to determine in-state expenditures by the road construction industry was distributed to the 75 members of the Associated General Contractors that participated in that type of construction activity. The questionnaire requested information on each firm's employment, expenditures by economic sector, and total construction contracts awarded. Although a response from each firm in the industry is desirable, it is extremely unusual to obtain a 100 percent response rate. Most firms completed the questionnaire, but several did not, making it necessary to use estimates for those firms. The information obtained from the questionnaires was used to estimate in-state expenditures by nonresponding firms so that the industry's total contribution would not be underestimated. Estimates of total contract awards for nonresponding firms were obtained from the Associated General Contractors (1986). The percentage of total contract awards spent in North Dakota by responding firms was applied to estimated contracts for nonrespondents; this calculation provided an estimate of in-state expenditures for the nonrespondents. Overall, 76 percent of the total contract value was estimated to be for purchases in North Dakota.

Similar procedures were followed to obtain in-state expenditures for the building and municipal/heavy construction firms. Questionnaires were distributed by the Associated General Contractors to just over 50 firms in these categories. Nonresponding firms' expenditures were estimated on the basic expenditure patterns for the respondents and total contract awards (Associated General Contractors 1987). Results for the building and municipal/heavy categories were kept separate so the contribution could be determined for each division.

Expenditures were allocated to their proper sectors and totaled for the responding firms, and each respective sector's share of the total was determined (Table 1). The distribution of expenditures for nonresponding firms was assumed to be similar to that for respondents. Applying the percentages from Table 1 to the estimated total in-state expenditures for nonrespondents distributed those expenditures to the respective economic sectors. Estimated in-state expenditures for nonrespondents were added to those of the respondents to obtain total outlays in North Dakota as a result of awarded road, building, and municipal/heavy construction contracts.

In addition to expenditures resulting from contract awards, a significant amount of money is spent on road construction and maintenance by local government units (county, township, and city). These expenditures data are not readily available, but a methodology was developed to estimate county expenditures. This methodology will not be presented in this report because it is discussed in great detail in Coon, Scott, and Leistritz (1986). Using this methodology provided acceptable estimates of road construction and maintenance expenditures for local governmental units.

It was also necessary to estimate the workforce for the road construction and maintenance firms not responding to the mail survey. Employment for the nonresponding firms was estimated on the basis of the number of full-time equivalent workers per total contracts for similar construction activities for the responding firms. County road construction and maintenance employment was not available and could not be estimated without surveying all counties to determine full-time equivalent road work employment. This was virtually impossible within the scope of this study.

TABLE 1. DISTRIBUTION OF IN-STATE EXPENDITURES BY ECONOMIC SECTOR FOR RESPONDING CONSTRUCTION FIRMS BY CONSTRUCTION CATEGORY, NORTH DAKOTA, 1985

Sector	Distribution of Expenditures		
	Road	Building	Municipal/ Heavy
	percent		
Nonmetallic Mining	5.6	2.4	5.6
Construction	22.3	56.6	--
Transportation	2.1	0.2	0.6
Communications & Public Utilities	1.1	0.4	0.8
Wholesale Trade & Misc. Manufacturing	9.8	11.8	27.1
Retail Trade	27.4	8.0	18.3
Finance, Insurance, and Real Estate	4.9	2.0	4.5
Business & Personal Services	1.1	1.1	2.6
Professional & Social Services	0.7	0.4	1.0
Households	25.0	17.1	39.5
Total	100.0	100.0	100.0

Employment estimates for nonresponding building and municipal/heavy construction firms were also provided by the Associated General Contractors (1987).

Input-Output Model

Defining an economic contribution analysis is beneficial before describing the methodology employed in a study of this type. An assessment of the effect that expenditures of an individual firm or industry in an area have on the economic unit in terms of economic variables (i.e., personal income, retail trade activity, and total business activity) is termed an economic contribution analysis. Gathering expenditures from each of the firms involved in construction activities, as previously discussed, was the first step necessary to perform the contribution analysis. These expenditures were applied to the North Dakota input-output model to determine their effect on the state's economy. This analysis measures the additions to the state's economy in terms of total business activity, personal income, and retail trade activity as well as secondary effects including employment and tax revenue collections. The analysis is in terms of current year (1985) dollars because expenditures were in terms of that year's dollar value.

Economic contribution analysis requires choosing a technique for estimating the indirect and induced effects of an industry on economic activity, employment, and income. Input-output (I-O) analysis was selected as the economic assessment framework for the North Dakota construction industry because it provides considerably more detailed estimates (i.e., business volume and employment by sector) than other techniques and I-O analysis 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 1976; Richardson 1972).

Input-output analysis is a technique for tabulating and describing the linkages or interdependencies between various industrial groups within the economy. The economy considered may be as large as the national economy or as small as that of a multicounty area served by one of the state's major retail trade centers. An input-output model previously developed for North Dakota (Leistritz et al. 1982) has been used extensively to estimate the economic contributions of a wide range of industrial sectors. (For a complete discussion 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. Input-output interdependence coefficients for North Dakota are presented in Appendix A, Table 1. Application of the local expenditures to the respective multipliers yields levels of business activity necessary to measure the economic contribution of the road construction industry. Because all local expenditures are in terms of 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, sometimes called the productivity 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 the road construction industry are applied to the multipliers, the resultant 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 through 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 used to estimate indirect and induced workers resulting from the road construction industry's expenditures are presented in Appendix A, Table 2.

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 are based on historic relationships between tax collections and input-output model estimates of gross business volume for selected sectors. Tax rates calculated were based on rates in existence in 1983 for North Dakota (Coon et al. 1984). Data were not available at this time to update the tax estimating equations to reflect the 1985 tax structures.

Estimates of state personal income tax collections were based on the following relationships:

North Dakota personal income tax collections = 2.1 percent X personal income

Personal income from the input-output model is the total business activity of the household sector. The equation to estimate state corporate income tax is as follows:

North Dakota corporate income tax collections = .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 tax collections were estimated based on the following formula:

North Dakota sales and use tax collections = 4.06 percent X retail trade activity

Retail trade activity is the total business activity of the retail trade sector of the input-output model. Applying these tax-estimating equations to the business activity generated from the local expenditures provides tax revenue estimations for the three major North Dakota taxes.

Model Validation

Comparing personal income for the household sector of the model with estimates of personal income published by the Bureau of Economic Analysis, United States Deparment of Commerce, provides a good indication of how accurately the input-output model simulates the North Dakota economy. North Dakota personal income estimates from the input-output model have had an average deviation from Department of Commerce estimates of 5.47 percent during the 1958-1984 period. (A year-by-year comparison of the personal income estimates is presented in Appendix A, Table 3.) The Theil coefficient for the state has a value of 0.066, indicating the model is quite accurate for predictive purposes.[2]

Economic Contribution

The economic contribution expenditures that each of the North Dakota construction industry subdivisions makes in the local economy were applied to the North Dakota input-output model to estimate their effects on the state's economy. This relationship resulted in estimates of business activity, personal income, retail trade activity, secondary employment, and selected tax revenue collections associated with the 1985 level of local expenditures. Contribution expenditures for the three categories also were summed to obtain the total for the entire industry. Results are reported for each of the construction categories and the industry total and as accruing to North Dakota. All results are reported in terms of current year dollars for 1985.

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[2]The Theil U_1 coefficient is a summary measure, whose value is bounded by 0 and 1. A value of 0 for U_1 indicates perfect prediction, while a value of 1 corresponds to perfect inequality (i.e., between the actual and predicted values). (For a further discussion of the Theil coefficient, see Leuthold [1975] and Pindyck and Rubinfeld [1981].)

Expenditures and Total Business Activity

Total local contribution expenditures attributable to the road construction industry amounted to over $154 million for the 1985 funding levels (Table 2). These expenditures were the total resulting from contracts awarded and county workforce road construction and maintenance. The largest amount of expenditures was to the retail trade sector, followed by the household and construction sectors. This would indicate that the industry purchases relatively large amounts of materials and uses a relatively large workforce in completing its road construction activities.

Expenditures by the building category were over $91 million in 1985 (Table 2). These expenditures were to many sectors of the economy with construction and households receiving the largest share. Sizable amounts of expenditures to the construction sector were for subcontracted work (e.g., drywall, bricklaying, electrical). Because these outlays for subcontracted construction were made primarily to firms or individuals not included in the Associated General Contractors membership, and therefore, not included in the survey, the full amount was included without substantial doublecounting. These subcontracted activities are part of the construction process and should be included as local expenditures. Relatively large outlays to the household sector indicate that a considerable part of the total expenditures for this type of construction activity is for wages and salaries.

TABLE 2. ESTIMATED LOCAL CONSTRUCTION CONTRIBUTION EXPENDITURES BY ECONOMIC SECTOR AND CONSTRUCTION CATEGORY, NORTH DAKOTA, 1985

Sector	Construction Category			
	Road	Building	Municipal/ Heavy	Total
	thousand dollars			
Nonmetallic Mining	6,759	2,232	1,647	10,638
Construction	26,837	51,583	--	78,420
Transportation	2,473	228	166	2,867
Communications & Public Utilities	1,332	337	248	1,917
Wholesale Trade & Misc. Manufacturing	11,827	10,714	7,917	30,458
Retail Trade	43,100	7,252	5,361	55,713
Finance, Insurance, and Real Estate	5,857	1,767	1,305	8,929
Business & Personal Services	16,552	1,011	745	18,308
Professional & Social Services	845	392	289	1,526
Households	38,535	15,588	11,523	65,646
Total	154,117	91,104	29,201	274,422

The municipal/heavy construction category had expenditures of over $29 million for 1985 (Table 2). Outlays by this group of firms were smaller than those for the other two. Households (i.e., wages and salaries to the workforce) received the largest share of the total expenditures for this category with nearly 40 percent of the total. Industry expenditures totaled over $274 million in 1985 (Table 2). Consistent with the distribution of expenditures for the three categories, the construction, household, and retail sectors received the largest amount of outlays at the industry level.

The economic contribution attributable to the road construction industry's expenditures included personal income of $131.3 million, retail sales activity totaling $119.3 million, and a total level of business activity of $427.9 million for 1985 (Table 3). Building category expenditures resulted in personal income of $72.5 million, retail sales activity of $51.9 million, and total business activity of $255.8 million for 1985. Personal income, retail trade, and total business activity for the municipal/heavy construction category amounted to $30.4 million, $22.7 million, and $95.9 million, respectively, for 1985. Personal income attributable to the construction industry was $234.2 million, and $193.9 million in retail trade activity resulted in North Dakota in 1985. Industry expenditures for 1985 were responsible for generating $779.5 million in total business activity. Construction industry expenditures of $274,422,000 in 1985 resulted in total business activity of $779,548,000, and thus, each dollar spent in the local economy generated another $1.81 for a total of $2.81.

TABLE 3. ESTIMATED PERSONAL INCOME, RETAIL SALES, BUSINESS ACTIVITY FOR ALL BUSINESS (NONAGRICULTURAL) SECTORS, AND TOTAL BUSINESS ACTIVITY FOR THE CONSTRUCTION INDUSTRY BY CONSTRUCTION CATEGORY, NORTH DAKOTA, 1985

Item	Construction Category			
	Road	Building	Municipal/ Heavy	Total
	thousand dollars			
Personal income	131,318	72,538	30,391	234,247
Retail sales	119,294	51,892	22,721	193,907
Business activity of all business sectors[a]	262,799	162,950	54,286	480,035
Total business activity	427,854	255,801	95,893	779,548

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

Tax Collections

Data in Table 3 provided the necessary measures of business activity to estimate tax revenue generated by the construction industry. Categories of tax revenue consisted of sales and use, personal income, and corporate income. Estimated tax revenues associated with the road construction industry totaled $8.4 million in 1985 (Table 4). The largest source of these revenues was the sales and use tax ($4.8 million), followed by state personal income tax ($2.8 million), and state corporate income tax ($0.8 million). Building and municipal/heavy construction firms were responsible for generating an estimated $4.1 million and $1.7 million of tax revenue, respectively, in 1985. The largest portion of these amounts was also from the sales and use tax category. Estimated construction industry tax revenues amounted to $14.3 million in 1985 with sales and use tax accounting for $7.8 million, state personal income tax totaling $4.9 million, and state corporate income tax amounting to $1.5 million.

TABLE 4. ESTIMATED TAX REVENUES ASSOCIATED WITH THE CONSTRUCTION INDUSTRY BY CONSTRUCTION CATEGORY, NORTH DAKOTA, 1985

Tax	Construction Category			
	Road	Building	Municipal/ Heavy	Total
	thousand dollars			
Sales and use	4,843	2,107	922	7,822
State personal income	2,758	1,523	638	4,919
State corporate income	815	505	168	1,488
Total	8,416	4,135	1,728	14,279

Employment

Direct employment for the construction industry can be measured in terms of either peak workforce or full-time equivalents. The two measures may differ substantially. The peak workforce indicates the maximum number of workers in the industry at the time of greatest activity, whereas expressing the workforce in full-time equivalents provides a measure of the number of persons working on a 12-months-per-year basis. Because employment expressed in terms of full-time equivalents is a more readily understood concept, the employment numbers in this report will be expressed in this manner. Full-time equivalent employment was determined from the information provided from the questionnaire administered to the construction industry firms and from data provided by the Associated General Contractors (1986; 1987).

Direct employment in the state's construction industry for 1985 was 3,614 workers (Table 5). Of this total, road construction employed 1,436 workers, building firms employed 1,504 workers, and the municipal/heavy firms provided 670 persons with employment.

TABLE 5. ESTIMATED DIRECT AND SECONDARY EMPLOYMENT ATTRIBUTABLE TO THE CONSTRUCTION INDUSTRY BY CONSTRUCTION CATEGORY, NORTH DAKOTA, 1985

Employment	Construction Category			
	Road	Building	Municipal/ Heavy	Total
Direct[a]	1,436	1,508	670	3,614
Secondary	7,425	4,227	1,396	13,048
Total	8,861	5,735	2,066	16,662

[a]In full-time equivalents.

Industry expenditures also are responsible for creating secondary (indirect and induced) employment in North Dakota. Secondary employment attributed to the state's construction industry amounted to 13,048 workers in 1985. Of this total, 7,425 indirect and induced jobs were created by road construction expenditures, 4,227 by building firms' expenditures, and 1,396 by municipal/heavy construction firms' outlays. As previously mentioned, productivity ratios were used to determine secondary employment, which means they were calculated based on the dollar injections into the local economy by the respective construction industries. The capital-intensive nature of the industry has resulted in ratios of secondary to direct employment higher than those for most other types of industries in the state. In other words, these firms have higher levels of expenditures per employee than do most of the other economic sectors, so secondary employment resulting from these outlays also tends to be higher than for most other sectors in the North Dakota economy.

Conclusions

The state's construction industry has the responsibility of building and maintaining the roads and streets necessary to transport products to their final market and to provide linkage between residents and the retail trade centers where goods and services may be obtained. Also, this industry provides the buildings and municipal services (water facilities, sewer, etc.) necessary to support the businesses and residents of the state. All three of these types of construction activites are necessary for the state's economy

and population to survive and grow. The construction industry contributes to the state's economy in yet another way. As construction industry expenditures are made within the state, these outlays contribute to the economy in the form of increased personal income, retail trade activity, and total business activity. The contribution this industry makes to the state's economy was estimated in terms of these economic variables for 1985.

Estimated local expenditures by the construction industry amounted to over $274 million for 1985. At this level of funding the industry generated total business activity of almost $780 million, personal income of $234 million, and retail sales activity amounting to $194 million. When the industry was separated into three categories (road, building, municipal/heavy construction), local expenditures for each were $154 million, $91 million, and $29 million, respectively. These expenditures generated personal income, retail trade activity, and total business activity attributable to the road construction firms ($131 million, $119 million, and $428 million, respectively), the building construction firms ($73 million, $52 million, and $256 million, respectively), and the municipal/heavy construction firms ($30 million, $23 million, and $96 million, respectively) for 1985.

Benefits of the construction industry also accrued to the state in the form of tax revenues, which were estimated to be $14.3 million for 1985. Sales and use tax collections accounted for the largest portion (55 percent) of the total. Estimated tax collections amounted to $8.4 million for the road construction firms, $4.1 million for the building firms, and $1.7 million for the municipal/heavy construction firms. In addition to the workers directly employed by the industry (3,614 full-time equivalent employees), secondary employment was generated as a result of the industry's outlays. This indirect and induced employment associated with the construction industry's expenditures amounted to 13,048 jobs, with road construction responsible for 7,425 indirect and induced jobs, building construction firms generating 4,227 secondary jobs, and the municipal/heavy construction firms creating employment for 1,396 secondary workers.

Because of the multiplier process, whereby a dollar injected into the economy "turns over" and creates additional "new" dollars, an additional $1.81 of business activity is created for each original dollar of construction industry expenditures. Thus, each original dollar injected into the economy, plus the $1.81 created, gave a total of $2.81 in total business activity.

The construction industry is a very important factor in the North Dakota economy. Its economic contribution is sizable when measured in such economic terms as personal income, retail sales activity, total business activity, tax revenue collections, and employment (direct and secondary). The magnitude of these key economic variables provides an indication of the contribution the construction industry makes to the state's economy.

Appendix A

TABLE A1. 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

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TABLE A1. 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 A2. GROSS BUSINESS VOLUME TO EMPLOYMENT (PRODUCTIVITY) RATIOS, BY ECONOMIC SECTOR, NORTH DAKOTA, 1958-1985

Year	(1)&(2) Agric	(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-Elec Generation	(16) Pet Exp/Ext	(17) Pet Refining
1958	9,444	53,846	6,486	1,768	10,644	19,169	19,939	29,783	5,122	4,798	--	3,030	2,894	--	8,828	39,104
1959	9,290	54,330	6,259	1,687	10,035	17,659	18,451	26,617	4,597	4,304	--	2,787	2,610	--	12,611	39,692
1960	8,887	55,284	7,409	1,624	9,760	17,353	17,593	24,713	4,275	4,045	--	2,660	2,610	--	19,568	39,682
1961	9,414	52,307	7,188	1,779	10,824	18,846	18,451	25,166	4,288	4,159	--	2,729	3,403	--	23,296	41,311
1962	11,016	69,565	6,986	2,168	13,605	18,827	23,753	30,488	5,179	5,102	--	3,260	3,937	--	27,786	42,229
1963	12,872	77,981	7,999	2,344	14,551	19,251	24,422	31,894	5,361	5,161	--	3,238	3,561	--	29,850	43,706
1964	12,649	82,300	8,972	2,503	16,086	18,583	25,087	33,178	5,523	5,566	--	3,286	4,297	--	30,516	46,014
1965	15,406	71,111	9,135	2,656	16,060	19,562	25,420	32,893	5,807	5,437	--	3,169	5,190	--	27,822	50,375
1966	17,930	77,037	11,896	2,933	17,673	21,005	28,358	36,465	6,543	6,012	--	3,414	5,649	23,404	30,742	53,007
1967	18,988	78,906	12,355	2,853	16,765	21,745	27,589	33,397	6,189	5,451	--	3,086	9,855	43,298	31,613	55,263
1968	19,376	84,800	14,093	3,046	17,968	21,858	29,140	35,118	6,561	5,654	--	3,071	13,056	63,730	37,650	58,203
1969	22,584	88,235	16,356	3,428	20,153	27,370	32,433	39,220	7,325	6,322	--	3,376	13,230	59,693	29,449	61,133
1970	27,374	129,545	26,968	4,002	24,828	28,071	36,472	46,044	8,012	6,987	--	4,036	16,167	57,740	45,862	71,296
1971	28,922	106,060	16,353	3,992	24,964	29,513	36,402	45,721	7,842	6,739	--	4,096	17,647	70,281	50,458	77,777
1972	38,088	134,108	17,549	4,932	30,102	32,432	42,244	54,486	8,816	7,804	--	4,923	17,914	79,553	55,781	85,500
1973	61,728	190,625	23,762	7,042	41,942	42,699	59,244	77,240	11,984	10,545	--	7,071	18,750	68,683	64,096	92,822
1974	66,322	200,000	25,637	7,763	45,645	44,746	63,783	81,936	12,619	11,207	--	7,736	23,876	71,794	99,225	113,930
1975	59,977	171,333	21,977	7,356	44,515	36,673	56,823	72,700	11,346	10,288	--	6,932	24,413	61,676	83,949	125,870
1976	52,517	151,923	16,800	7,019	41,584	43,572	50,590	64,487	10,626	9,483	--	6,424	42,996	109,039	81,215	137,128
1977	46,259	146,583	16,377	6,615	39,361	40,263	49,143	58,964	10,220	9,038	--	6,207	42,737	129,329	66,699	147,058
1978	59,804	170,303	17,481	7,264	42,991	42,946	57,438	66,303	11,471	9,996	--	7,057	43,665	180,165	48,564	154,368
1979	70,488	192,012	20,660	7,904	45,971	48,201	62,930	72,542	12,019	11,058	--	8,013	57,794	248,913	60,578	233,696
1980	74,811	215,297	28,091	8,903	50,255	55,070	70,394	78,103	12,793	12,253	--	9,014	69,524	311,139	84,707	360,075
1981	85,034	243,533	36,367	10,977	58,170	57,768	83,851	89,267	14,125	13,439	--	10,594	67,983	282,730	134,764	618,212
1982	83,235	218,788	30,620	10,309	55,042	53,484	77,073	82,571	12,691	11,723	--	9,826	64,293	292,948	144,954	642,088
1983	93,635	240,042	31,356	11,662	64,527	58,772	87,188	92,571	14,018	12,973	--	11,007	77,439	327,880	195,633	586,323
1984	89,709	235,428	39,555	11,182	63,442	58,600	83,061	90,309	13,241	12,961	--	10,875	84,996	350,310	174,591	558,256
1985	97,508	251,524	48,099	11,459	66,979	62,363	86,546	93,958	13,884	13,198	--	11,312	131,424	383,431	159,657	515,783

TABLE A3. ESTIMATES OF PERSONAL INCOME AND DIFFERENCES IN ESTIMATES, NORTH DAKOTA, 1958-1984 (THOUSAND DOLLARS)

Year	Department of Commerce Estimate	I-O Analysis Estimate	Percent Difference
1958	--	1,022,412	--
1959	1,008,057	978,420	- 2.94
1960	--	942,488	--
1961	--	1,011,462	--
1962	1,460,980	1,285,790	-11.99
1963	--	1,353,864	--
1964	--	1,521,191	--
1965	1,497,762	1,470,129	- 1.84
1966	1,555,539	1,662,394	6.87
1967	1,595,042	1,573,010	- 1.38
1968	1,643,964	1,684,451	2.46
1969	1,850,417	1,890,973	2.19
1970	1,913,283	2,117,319	10.66
1971	2,158,416	2,156,642	- 0.08
1972	2,676,385	2,601,416	- 2.80
1973	3,841,862	3,674,738	- 4.35
1974	3,739,859	4,104,667	9.75
1975	3,755,431	4,009,827	6.77
1976	3,828,880	3,860,970	0.84
1977	3,982,404	3,829,503	- 3.84
1978	4,798,839	4,481,331	- 6.62
1979	5,228,461	5,187,221	- 0.79
1980	5,657,789	5,390,502	- 4.72
1981	7,123,641	6,899,460	- 3.15
1982	7,306,383	6,305,332	-13.70
1983	7,936,951	7,223,150	- 8.99
1984	8,479,079	7,324,837	-13.61
Absolute Average Difference			5.47

Mean = -1.875 (S.D. = 6.626)

Theil's U_1 Coefficient = .066

Appendix B

North Dakota General Contractors Economic Survey

General Instructions

This questionnaire is designed to help provide us with information on your firm's employment and purchases in North Dakota. All information provided will be kept strictly CONFIDENTIAL. Individual firm's characteristics will not be disclosed in the final published tables nor will such information be released.

An envelope is provided for your use in returning the questionnaire.

Please indicate your firm's name and identify a person who can be contacted if clarification is needed later:

Firm Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Contact Person: _____

Phone Number: _____

If you have questions, please contact:

Randal Coon
Project Coordinator
Department of Agricultural Economics
North Dakota State University
Fargo, ND 58105
701-237-7451

or

Curt Peterson
Executive Vice President
Association of General Contractors
Avenue A and Second Street
Bismarck, ND 58502

NOTE: All information requested is for calendar year 1986 (January 1 through December 31).

I. Employment

Please indicate the employment at your firm for construction activities in North Dakota.

Number of Employees

Year	Full-time	Part-time	
		Number	Full-time Equivalents*
1986			

*The number of part-time workers can be converted to full-time equivalents using a 12-month basis. For example, two workers each hired for 6 months would equal one full-time equivalent.

II. Expenditures

Instructions (Read Carefully)

* Include only those expenditures that are made to individuals or businesses in North Dakota. Do not include payments made in other states even though the product or service was delivered to your firm in North Dakota.

* Use year ending December 31, 1986, in completing this section.

* Information should be recorded in dollars.

* If your firm is an affiliate of a national firm, the data should be only for the North Dakota operation(s).

* When a miscellaneous category must be used, please specify what this category includes.

* When exact information is not readily available, please estimate. Also indicate entries that are estimated.

* While we would like the best data that are practicable, we do not expect you to spend an excessive amount of your time to provide exact amounts, especially for small items. In other words, a degree of precision of 10 or 15 percent would be adequate for expenditures that are minor components of total expenditures while a higher degree of precision is more important for the larger expenditure items.

* For those companies where there are two or more partners, only the managing partner is requested to furnish the total amount of revenues and expenditures or the requested breakdown. Minority partners should not report the same data furnished by the managing partner.

* It is very important to include the total revenue resulting from North Dakota construction activities for your firm on the following page. Total revenue could also be the value of contracts awarded or total income, whichever applies to your firm.

* In itemizing expenses, those firms that write the initial check for said expenses should include same, regardless of whether it is passed on to customers.

A. Please give a breakdown (on following page) of your total expenditures that relate to construction in North Dakota. Only include expenditures to North Dakota businesses. See page 5 for definitions and expense classifications.

Total Expenditures Made to North Dakota Businesses and Individuals for Construction Activities in the State

Sector Payments Were Made To	Amount of Expenditures in 1986
Sand and Gravel Mining	
Sublet Construction	
Transportation	
Communications	
Public Utilities	
Wholesale Trade	
Retail Trade	
Finance, Insurance, Real Estate	
Business and Personal Services	
Professional and Social Services	
Payrolls	
Benefits	
Other (Please Specify)	

Total Revenue Associated with North Dakota Construction Activities for 1986: $_____

Definitions of Industries

(According to the Standard Industrial Classification Manual)

Construction:
Includes: Building construction--general contractors engaged in construction of residential, farm, industrial, public, and other buildings. (Division C - 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. (All of Division E except Major Groups 48 and 49)

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

Public Utilities:
Includes establishments engaged in the generation, transmission, and/or distribution of electric energy for sale and natural gas companies engaged in the transmission, storage, or distribution of natural gas. Also, water supply and sanitary services are included. (Major Group 49)

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. (Division F)

Retail Trade:
Includes establishments engaged in selling merchandise for personal, household, or farm consumption, and rendering services incidental to the sale of the goods. (Division G)

Finance, Insurance, and Real Estate:
Includes institutions engaged in banking, or other financial institutions, insurance, and real estate. (Division H)

Business and Personal Service:
Includes firms operating lodging services, repair, laundry, entertainment, other personal services predominantly to private individuals, credit collectional, janitorial, and stenographic services. (All of Division I Except Major Groups 80, 81, 82, 83, 86, and 89)

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, 86, and 89)

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