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THE CONTRIBUTION OF THE ROAD CONSTRUCTION AND MAINTENANCE INDUSTRY TO THE NORTH DAKOTA ECONOMY

Randal C. Coon
Donald F. Scott
F. Larry Leistritz

Department of Agricultural Economics
Agricultural Experiment Station
North Dakota State University
Fargo, North Dakota 58105

Preface

The work upon which this report is based was partially supported by funds from the Associated General Contractors of North Dakota. The purpose of this research was to determine the economic contribution the road construction and maintenance industry makes to the North Dakota economy. This industry is important to the state not only because it maintains the road transportation network but also through its expenditures into the local economy. In-state expenditures by the industry were obtained through a mail survey of firms involved in road construction in North Dakota. These expenditures were applied to the North Dakota Input-Output model to estimate the economic contribution (i.e., personal income, retail trade activity, and total business activity) associated with the road construction and maintenance industry in North Dakota for 1985.

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Highlights

The North Dakota road construction and maintenance industry is an important component of the state's economy. This industry is important not only in the context that it maintains the road transportation network in the state (a vital link between people, raw products, markets, and goods and services) but also through expenditures into the local economy. This study estimates the contribution the industry makes to the economy of North Dakota in terms of the values of economic variables for 1985.

In-state expenditures by the industry were obtained through a combination of a mail survey, a telephone survey, and secondary data. All firms involved in road construction work in North Dakota were mailed a questionnaire to obtain their expenditures data. In order not to understate the contribution of the industry, nonresponding firms' expenditures were estimated based on their contract awards and on comparable data provided by respondents to the mail survey. County outlays for road construction and repairs by their work force were included in the analysis as part of the industry. County road construction budgets were estimated using primarily secondary data and information obtained from a telephone survey on the distribution of these funds. Only money spent by the counties for road work involving their workforce was considered applicable because contracted county road work would be captured in the expenditures data obtained by the mail survey.

An input-output model previously developed for North Dakota was used to analyze the road construction industry's contribution to the state economy. Application of local expenditures to the interdependence coefficients provides measures of key economic variables. The industry was analyzed for the 1985 level of funding and also for $5 million and $10 million higher funding scenarios. Local expenditures were estimated at $154 million for the current funding and at $158 million and $162 million for the alternative scenarios. At the 1985 funding level the industry generated personal income amounting to $131 million, retail sales activity of $119 million, and total business activity of $428 million. If the industry were funded an additional $5 million, the resulting personal income, retail trade activity, and total business activity would have been $135 million, $122 million, and $439 million, respectively; corresponding values for the $10 million additional funding scenario would be $138 million, $125 million, and $449 million, respectively. Total tax revenues resulting from the industry's expenditures were $8.4 million for 1985; $4.8 million in sales and use tax collections constituted the largest share of the total. Total tax collections associated with the two higher funding scenarios would be $8.6 million and $8.8 million, respectively.

Direct employment by the road construction industry amounted to 1,436 full-time equivalent workers in 1985 with a peak workforce of 3,806 employees. In addition to the direct workforce, 5,257 secondary jobs were generated as a result of the industry's expenditures by private firms; the total for the industry was estimated to be 7,425 secondary jobs. When

considering the multiplier process (where a dollar injected into the local economy creates "new dollars"), the road construction industry creates an additional $1.78 of business activity for each original dollar spent locally. Thus, each original dollar the industry spends in the local economy plus the created $1.78 gives a total of $2.78 in total business activity. These key economic variables provide an indication of the economic importance of the road construction and maintenance industry to the economy of North Dakota.

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Randal C. Coon, Donald F. Scott, and F. Larry Leistritz*

Introduction

North Dakota is a rural state which relies upon its transportation system to carry people and products to their destinations. The state's highway network, which is a very important component of the transportation system, links people to the goods and services they require on a day-to-day basis. Also, the highway system provides a means of transporting the state's products to markets and a mode for distributing the goods demanded by North Dakota residents. Because of its rural nature, North Dakota has 163 miles of roads, streets, and trails per thousand population; this is more miles per capita than any other state in the nation (North Dakota State Highway Department 1986a).

North Dakota has in excess of 100,000 miles of roads, almost 70 percent of which are surfaced (Table 1). The state highway system services all parts of the state, although the highest concentration of roads is in the more densely populated eastern one-third of the state (Figure 1). Interstate highways, which are also a part of the state highway system, cross the state from east to west and north to south. Construction and upkeep of this vast highway system cost a tremendous amount of money; the current cost is at $850,000 per mile for rebuilding a highway (i.e., recycling a two-lane interstate highway). (For a complete listing of the average costs for highway construction in North Dakota, see Appendix A, Table 1). Repair and maintenance of roads and streets is an ongoing and costly activity in North Dakota. Weather, soil composition, load weight, and frequency of travel all contribute to the need for constant repairs to roads and streets. These costs range as high as $6,210 per mile for street repairs in North Dakota's major cities (Appendix A, Table 2 contains a breakdown of highway maintenance costs for several different types of roads).

The large expense associated with construction and maintenance of the state's highway system has led to the highway construction industry's becoming a very important component of the North Dakota economy. The economic contribution this industry makes to the state is determined in this study as well as the industry's economic contribution for two higher funding scenarios. 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 road construction and repair 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

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*Coon is research specialist, Scott and Leistritz are professors, Department of Agricultural Economics, North Dakota State University, Fargo.

TABLE 1. EXISTING MILEAGE OF NORTH DAKOTA ROADS AND STREETS CLASSIFIED BY SYSTEMS AND SURFACED AND UNSURFACED TYPES, 1984

System	Roads and Streets		Total
	Surfaced[a]	Unsurfaced[b]	
	miles		
State			
Interstate	571.1	--	571.1
Primary	5,532.2	3.0	5,535.2
Secondary	1,119.7	2.9	1,122.6
Urban	26.3	--	26.3
State system only	32.1	--	32.1
County - federal aid secondary	9,323.2	71.2	9,394.4
Other rural roads and streets	53,597.0	32,784.6	86,381.6
Incorporated city streets	3,150.0	167.9	3,317.9
Total	73,351.6	33,029.6	106,381.2

[a]Surfaced roads include hard surface (bituminous and concrete) and gravel.
[b]Unsurfaced roads include graded and drained and unimproved roads and trails.

SOURCE: North Dakota State Highway Department 1986b.

impacts accrue within the state. Secondary impacts include indirect and induced employment and tax revenues. Similar analyses have been performed for many plants and industries in North Dakota; for example, the lignite industry (Coon and Leistritz 1986), the potato industry (Coon, Leistritz, and Scott 1986), the recreation industry (Mittleider and Leitch 1984), a livestock slaughter plant (Wulff, Petry, Helgeson, and Coon 1986), the North Dakota State University (Coon, Leistritz, and Hertsgaard 1986), and agriculture (Coon, Vocke, and Leistritz 1984) have all been recently analyzed to determine their effects on the state's economy. Measuring, in terms of economic variables, the road construction industry's contribution to the economy of North Dakota provides an indication of the importance of the industry to the state's economy.

Road Construction Industry

The road construction and repair industry consisted of approximately 75 firms operating in North Dakota during the 1985-1986 period. These firms range in size from ones that employ several workers to those that have a peak annual workforce of several hundred. Annual contract awards to the businesses in the industry also vary considerably, with some firms totaling near $50 million. A wide variety and combination of services are offered by the firms

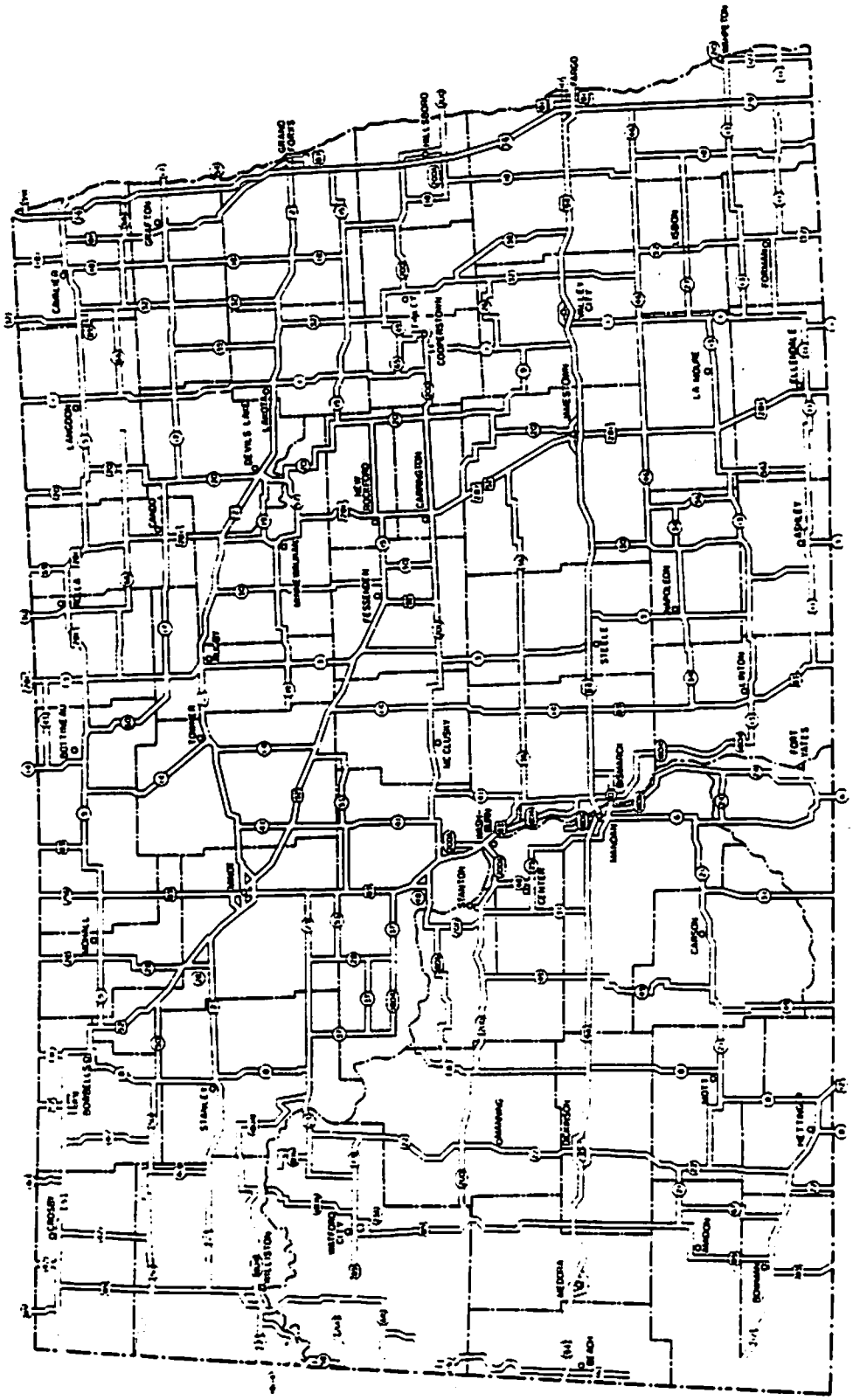

Figure 1. The State Highway System in North Dakota

in this industry--services that range from sand and gravel operations to complete road construction or replacement.

At the present time the road construction industry is primarily involved in road maintenance and repair. Very little money is currently being spent in North Dakota for the building of new roads; most new construction activity is by incorporated cities for development of their own arterial and street systems. The heavy use of the state's road system provides an indication of the need for constant maintenance. Over 5.5 billion vehicle miles were traveled on North Dakota's roads and streets in 1984, a 22.2 percent increase since 1975 (Figure 2). (For a detailed breakdown of vehicle miles traveled on each road type in 1984, see Appendix A, Table 3). Use of the state's roads may create a need for repair and maintenance, but in reality the work that is done is a function of a tax system and budgetary process.

Construction and maintenance of North Dakota road and street mileage is the responsiblity of five separate administrative jurisdictions: federal, state, counties, organized townships, and incorporated cities. All of these jurisdictions fund their road and street construction and repairs through taxes levied or the transfer of tax revenue collected by another

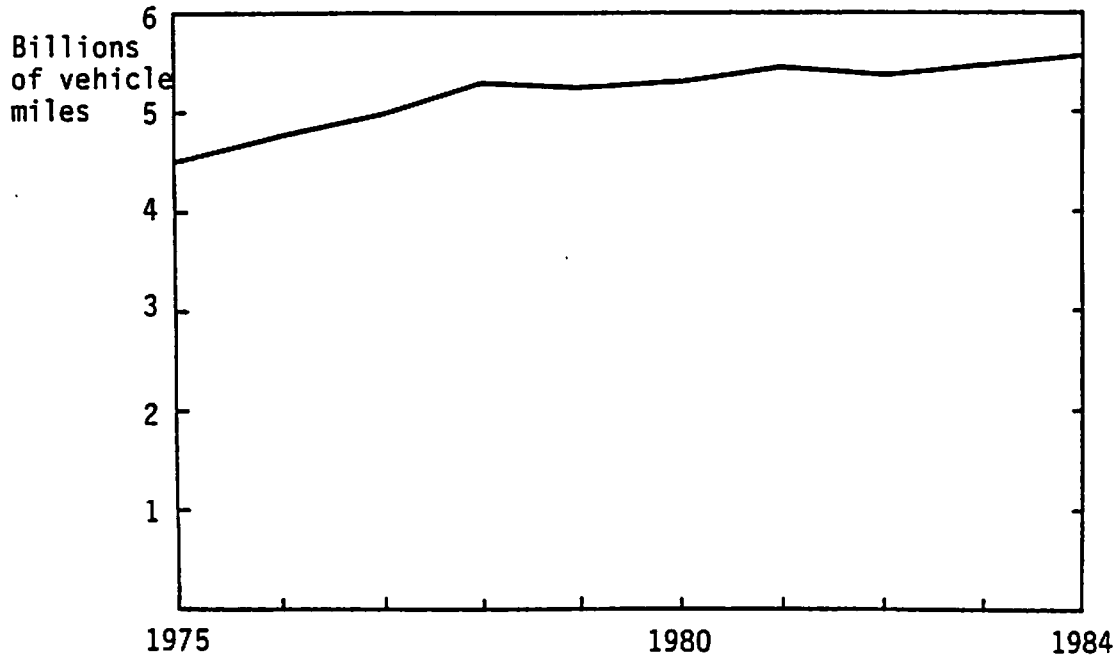

Figure 2. Annual Vehicle Miles of Travel on All Roads and Streets, North Dakota, 1975-1984

SOURCE: North Dakota State Highway Department 1986b.

jurisdiction.[1] The method of funding work done by the road construction industry makes it different from the rest of the construction industry and, for all practical purposes, different from most industries in the state. The industry is comprised principally of privately-owned companies, although some of the repair work is done by counties and cities with their equipment and employees. Because of the influence tax collections and transfers have on the industry, it is very sensitive to changes in funding programs. Federal, state, and local programs that fund the road construction industry will be presented in the section that follows.

Financing the State's Road Construction

Financing for the construction and maintenance of North Dakota's highway system is attained through a combination of federal, state, and local funds. As previously mentioned, responsibility for the state's road and street mileage is separated into five administrative jurisdictions (federal, state, counties, organized townships, and incorporated cities). Roads located in national parks, forests, and reservations are under federal jurisdiction. State highways consist of the interstate, primary, secondary, and urban systems. County highways consist of a designated federal highway aid system of local roads and a regular county road system. Counties also have the responsibility for construction and maintenance of bridges on local roads and streets. Organized townships have jurisdiction over their roads which serve local rural travel, and incorporated cities are responsible for development of their own arterial and other street systems. Funding from each of the three sources to the five jurisdictions will be discussed briefly to provide an indication of where the money comes from and how it is distributed.

Federal Funding

The Federal-Aid Highway Program, initiated in 1916, provides federal assistance to state-administered highway programs. This program provides federal funds to states to construct and improve urban and rural highway systems. The Federal-Aid Road Act of 1916 and the Highway Act of 1921 provided the foundation for the Federal-Aid Highway Program as it exists today. Major enhancements to early laws were the establishment of the Federal

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[1]Because much of the money collected to finance road and street construction comes from taxes on North Dakota residents, this study is technically a contribution analysis (as opposed to an impact analysis). A contribution study consists of analyzing the effects all expenditures by an industry have on the state's economy. In contrast, an impact assessment would determine the effect additional (or new) money brought into the state would have on its economy. It can be assumed that, if the taxes financing road work were not in place, the state's residents would spend that money on other in-state purchases. For this reason, and to maintain conceptual consistency, this study will be termed a contribution analysis. Although this is a rather technical detail, it is important to remember when reviewing studies of other industries.

Highway Trust Fund in 1956 and passage of the Surface Transportation Assistance Act in 1982. The Surface Transportation Assistance Act increased motor fuel tax from $.04 to $.09 per gallon. In 1984 truck taxes were reduced and an additional $.06 per gallon diesel tax was adopted, giving a total of $.15 per gallon. (For a complete description of the current federal highway user fees, see Appendix A, Table 4). Federal-Aid Highway Program funds transferred to North Dakota totaled $85.3 million in 1985 (Table 2). Funding from this source has increased in recent years, a direct result of the increased rates installed by the Surface Transportation Assistance Act.

Federal-Aid highway funds are distributed to several major programs in the state. Key programs include (1) Interstate Highway, (2) Interstate Rehabilitation, (3) Primary System, (4) Rural Secondary, (5) Bridge, and (6) Urban. The amount of money distributed to each of these programs for the 1976 to 1985 period is presented in Table 2.

The Interstate Highway program is an ongoing effort to complete the interstate highway system, and upon its completion, the state can transfer funds into other federal highway programs. In order to rehabilitate and upgrade the existing interstate highways, the Interstate System Rehabilitation program was created. These projects are funded with 90 percent federal and 10 percent state matching funds.

The Primary System program allocates funds for main rural highways and urban extensions that connect major population centers and provide main connections with other states. Projects are funded with 76 percent federal and 24 percent state matching funds under this program. Lower volume roads where purposes are to connect smaller population centers and to connect to the primary or interstate highways are funded under the Rural Secondary (Federal-Aid Secondary) program.

Federal-state matching (76-24 percent) guidelines similar to those used for primary system projects are used for the Rural Secondary projects. The Bridge Program appropriates funds to replace or rehabilitate deficient or obsolete structures. An 80 percent federal and 20 percent state or local funds matching ratio exists for this program. The Urban Program designates money for urban arterial systems in North Dakota cities with populations over 5,000. A broad range of projects is covered under this program, which also uses the 76 percent federal-24 percent local matching funds ratio.

In addition to the major programs mentioned, numerous other minor ones (e.g., highway planning and research, highway safety, transit, federal land and forest highways, and access highways and lakes) exist and are funded at various levels with different matching ratios. For a complete discussion of the formulas used to distribute the federal funds into the respective programs, see North Dakota State Highway Department (1986b).

State Funding

Emphasis of the state funding for highway construction is primarily on preserving the existing highway network. The Highway Distribution Fund, which

TABLE 2. FEDERAL-AID HIGHWAY PROGRAM FUNDS AND APPORTIONMENTS, NORTH DAKOTA, 1976-1985

Fiscal Year	Federal-Aid Highway Funds	Federal-Aid Highway Apportionments							
		Interstate Program	Interstate Rehabilitation	Primary Highways	Secondary Highways	Bridge Program	Urban Program	Other	Total
	million dollars								
1976	50.6	15.0	--	12.6	5.7	--	4.4	12.9	50.6
1977	47.7	0.4	--	18.3	10.7	0.3	7.9	10.1	47.7
1978	53.5	15.8	2.4	12.1	5.2	0.5	3.9	13.6	53.5
1979	55.4	15.6	2.4	12.7	6.2	4.1	3.8	10.6	55.4
1980	59.6	15.6	1.9	14.0	6.9	5.8	3.8	11.6	59.6
1981	71.5	16.8	1.9	14.9	7.5	8.0	3.8	18.6	71.5
1982	73.2	16.8	2.9	11.9	4.9	19.4	3.8	13.5	73.2
1983	70.4	14.9	6.7	14.5	8.0	7.1	3.8	15.4	70.4
1984	78.4	17.7	16.2	16.4	8.1	7.0	3.9	9.1	78.4
1985	85.3	17.9	19.8	18.2	8.0	7.9	3.9	9.6	85.3

SOURCE: North Dakota State Highway Department 1986b.

is funded primarily by user fees, is allocated to the State Highway Department (63 percent), counties (23 percent), and cities (14 percent). In fiscal year 1984-1985, $85.3 million was allocated through the Highway Distribution Fund using these percentages. Motor fuel taxes and vehicle registration fees are the primary sources of revenue for this fund.

Current state motor fuel tax rates are $.13 per gallon on gasoline and special motor fuels (mostly diesel fuel) and $.05 per gallon on gasohol. Motor fuel taxes are the largest source of revenue going into the Highway Distribution Fund; in 1985, gasoline, gasohol, and diesel fuel taxes generated $49 million, or 57 percent of the total (North Dakota State Highway Department 1986b). Special fuels used for agricultural, railroad, industrial, and heating purposes are exempt from the fuels tax but are subject to a 2 percent excise retail sales tax. This tax generated $6.0 million in 1985.

A 4 percent use tax is levied on the net price of motor vehicles purchased at retail outside of the state for use in North Dakota. One-half of this revenue ($1.4 million in 1985) goes to the Highway Distribution Fund, and the other half goes to the state general fund. Motor vehicles are licensed in North Dakota according to age and weight (i.e., passenger vehicles according to the manufacturer's shipping weight and trucks by the owner's declared gross weight). These fees generated $28.5 million in 1985, which was about one-third of the total going to the Highway Distribution Fund. Table 3 presents a detailed breakdown of the revenue sources and allocation of the Highway Distribution Fund in 1985.

TABLE 3. REVENUE SOURCES AND ALLOCATIONS FOR THE HIGHWAY DISTRIBUTION FUND, NORTH DAKOTA, 1985

Revenue Source	State Highway Department	Counties	Cities	Total
	million dollars			
Gasoline	23.0	8.5	5.0	36.5
Gasohol	0.3	0.1	0.1	0.5
Special fuel tax	7.5	2.8	1.6	11.9
Blended special fuel tax	a	a	a	a
Special fuels 2% excise tax	3.8	1.4	0.8	6.0
Motor vehicle registration fees	18.0	6.7	3.9	28.6
Motor vehicle 4% use tax	0.9	0.3	0.2	1.4
Other	0.2	0.1	0.1	0.4
Total	53.7	19.9	11.7	85.3

[a]Less than $150

SOURCE: North Dakota State Highway Department 1986b.

The State Highway Fund is made up of revenues generated from trucking fees, escort service fees, moving permit fees, trip permit fees, and driver's license fees. All revenues collected from these sources go to the State Highway Department and are used for construction and maintenance of the state highway system. These fees generated approximately $5.1 million in 1985--truck fees accounted for $3.4 million and driver's license fees for $1.7 million. Also, a small amount of money is generated as the result of the sale of equipment and land, leasing hayland, and various service charges.

Local Funding

Local roads and streets are vital to economic growth because they provide a means for farm products to be marketed and a link between consumers and retail trade centers. A major problem with these roads is the large number of miles that serve a relatively small number of residents, and thus a very high cost per mile per capita to build or maintain. A situation which has compounded this problem is the elimination of the federal revenue sharing program (it was discontinued after the third quarter in 1986), because most local governments used some portion of the money for road and street construction and repairs.

County sources of revenue for roads and bridges are local property taxes and the country's share of the Highway Distribution Fund. As previously mentioned, counties receive 23 percent of the State Highway Distribution Fund, which amounted to almost $20 million for all counties in 1985 (Table 3). Counties also have several local mill levies that can be used for roads and bridges. Counties can levy up to 23 mills for general, special, or road and bridge purposes; in addition, they may also issue bonds, transfer revenue from other funds, and borrow money for constructing or repairing roads and bridges. North Dakota counties levied over $15 million for road purposes in 1985 (for a county breakdown of taxes levied, see Appendix A, Table 5).

Townships do not receive any of the State Highway Distribution Fund; however, they do receive $.01 of the state motor fuel tax if they are organized (if they are unorganized, the money is transferred to the county). This revenue amounted to about $4.6 million in 1985 (North Dakota State Highway Department 1986a). The board of township supervisors may levy up to 18 mills for general road purposes, and electors of each township at the annual meeting may levy up to 5 mills for constructing and maintaining federal-aid and farm-to-market roads.

Cities have more flexibility in raising revenue for their street system. Street projects may be financed by general obligation bonds, special assessments, the cities' share of the State Highway Distribution Funds, or local property taxes; however, general obligation bonds and special assessments are the most common. Cities' share of the State Highway Distribution Fund (14 percent) amounted to about $11.7 million in 1985 (North Dakota State Highway Department 1986a). Cities may levy up to 38 mills, and some portion of these funds is generally used for street improvements.

Methodology

The economic contribution of the road construction and maintenance 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 expenditures. The contribution the road construction industry makes to the state's economy will be reported for 1985 because firms responding to the mail survey had not completed their 1986 accounting procedures; in order to respond in a timely manner the requested data were obtained from their 1985 records. Using 1986 expenditures would have required a significant amount of estimation by the firms and also estimates of necessary secondary data because 1985 was the latest year these data were available. All results are reported in terms of 1985 dollars and as accruing to the state rather than to particular regions.

Local Expenditures

A questionnare to determine in-state expenditures by the road construction industry was distributed to the approximately 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 have 100 percent response. Most firms completed the questionnaire, but several did not, making it necessary to use estimates for those firms. The information obtained from the questionnaires allowed nonresponding firms' in-state expenditures to be estimated so as to not understate the industry's total contribution. 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. A 76 percent share of total contracts was assumed to be for purchases in North Dakota.

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 4). The distribution of expenditures for nonresponding firms was assumed to be similar to that for respondents. Applying the percentages from Table 4 to the estimated total in-state expenditures for the 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 construction contracts.

TABLE 4. DISTRIBUTION OF IN-STATE EXPENDITURES BY RESPONDING ROAD CONSTRUCTION FIRMS BY ECONOMIC SECTOR, 1985

Sector	Distribution of Expenditures
	-------- percent ----------
Nonmetallic Mining	5.6
Construction	22.3
Transportation	2.1
Communications & Public Utilities	1.1
Wholesale Trade & Misc. Manufacturing	9.8
Retail Trade	27.4
Finance, Insurance, and Real Estate	4.9
Business & Personal Services	1.1
Professional & Social Services	0.7
Households	25.0
Total	100.0

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 were not readily available, but a methodology was developed to estimate county expenditures; it was virtually impossible to estimate township and city expenditures, but county outlays were believed to constitute a major portion of the local government total. County receipts for local roads and streets were available for 1981 (North Dakota State Highway Department 1981). However, that data series was discontinued and was not available for 1985 in published sources. Most of the major component revenue sources for counties were available through unpublished data from the Planning Division of the North Dakota State Highway Department. Most of these data were available at the state level only, so county revenues for local road work were estimated at that level. This is not a concern because the contribution analysis is for the statewide road construction industry.

Estimated total county receipts for local roads were almost $68 million statewide for 1985 (Table 5). Data for the eleven major accounts comprising this total were obtained from a combination of unpublished data, secondary data, telephone surveys, and adjusting previous account totals. Property tax levies, highway distribution, and county federal-aid secondary were actual 1985 values (Appendix A, Tables, 5, 6, and 7, respectively), although they had not been published (North Dakota State Highway Department 1986c). Personal property tax replacement and homestead credit also were actual data that had not yet been published (North Dakota Tax Department 1986). Oil and gas production tax data were obtained from a survey of county auditors of the major oil producing counties; the remaining counties' values were obtained by indexing 1980 receipts (North Dakota State Highway Department 1981) by a factor determined from the telephone survey. State revenue sharing, transfers

TABLE 5. ESTIMATED STATE TOTAL COUNTY RECEIPTS FOR LOCAL ROADS AND STREETS, NORTH DAKOTA, 1985

Item	Amount
	-- thousand dollars --
Property Tax Levies	15,438
Highway Distribution	18,805
Personal Property Replacement & Homestead Credit	1,769
Gas & Oil Production Tax	9,130
State Revenue Sharing	549
Transfers From Other Funds	1,249
Federal Revenue Sharing	4,388
County Federal-Aid Secondary Program	6,050
Bridges Off-Road	3,215
Bridges Secondary	1,570
Access Highways-Recreation	5,500
Total	67,663

from other funds, and federal revenue sharing were believed not to have changed signficantly from the 1980 amounts, so those were assumed to be applicable for 1985. Federal revenue sharing amounts distributed to North Dakota did not differ significantly for 1980 and 1985 so the earlier value was used for the 1985 county totals (Community Services Administration 1981; United States Department of Commerce 1986). It was assumed that the portion of federal revenue sharing funds allocated for county road work remained the same for the 1980 to 1985 period. Bridges off-road, bridges secondary, and access highways-recreation receipts were not available, but estimates were provided by the North Dakota State Highway Department (1986c).

Not all of the county road budget was considered applicable for this analysis. The portion of the county budget which was used to contract highway construction or maintenance would already have been captured in the survey administered to the Associated General Contractor members. Data were not available to allocate the county budget between contract expenditures and those for work done by their own workforce. A telephone survey provided estimates of the percentage distribution of the county's road budget for contracted roadwork and for that done by the county workforce, and the distribution of county expenditures (i.e., labor, materials, and capital purchases). County road expenditures were split equally for this analysis (50 percent for each) between contract and work done by the county employees (Table 6). Statistical results were 42-58 percent for the average and 50-50 percent for the median and mode; because all three tests indicated a near equal split, the budget was assumed to be divided equally between contract and county work. The county workforce expenditures were further divided into three categories: (1) labor, (2) materials and services, and (3) capital purchases. Results of the survey indicate a consistent trend when comparing the average, median, and mode. The averages were selected for allocating

TABLE 6. RESULTS OF TELEPHONE SURVEY TO DETERMINE THE DISTRIBUTION OF COUNTY ROAD EXPENDITURES, 1985

Statistic	County Road Expenditures		County Road Workforce Expenditures		
	Contract	County Workforce	Labor	Materials & Service	Capital
Number of Observations	11	11	10	10	10
	percent				
Average	42	58	30	50	20
Median	50	50	33	50	13
Mode	50	50	33	50	10
High	62	80	44	73	50
Low	20	38	17	20	7

county expenditures for labor (30 percent), materials and service (50 percent), and capital purchases (20 percent). Labor expenditures were allocated to the household sector of the input-output model, materials and services were divided one-half each to the retail trade sector and the business and personal services sector, and capital purchases were placed in the retail trade sector.

It was also necessary to estimate the workforce for the 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.

The contribution analysis for the road construction industry was performed for the estimated actual level of expenditures and for two higher levels of funding. Higher funding scenarios included one with $5 million and another with $10 million additional funding available for road construction. It was assumed that these funds would be used for contracted road construction and repairs, that the percentage of the total spent in-state would be similar to that from survey respondents (76 percent), and that expenditures would be distributed among the sectors in accordance with survey results (Table 4).

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 road construction and maintenance, 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 road construction industry because it provides considerably more detailed estimates (i.e., business volume and employment by sector) than other techniques 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 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 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. 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 8. 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 is that which will arise 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 road construction industry expenditures are presented in Appendix A, Table 9.

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 5.46 percent during the 1958-1984 period. (A year-by-year comparison of the personal income estimates is presented in Appendix A, Table 10). 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 the North Dakota road construction and maintenance industry 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 for the 1985 level of funding and also for two higher levels of funding (i.e., $5 million and $10 million). Results will be reported for each of the levels of funding and as accruing in North Dakota. All results are reported in terms of current year dollars for 1985.

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 7). Estimated local expenditures for the two alternative funding levels were almost $158 million and $162 million, respectively, for the same period (Table 7). These expenditures were the total resulting from contracts awarded and county workforce road construction and maintenance. The largest amount of expenditures for all three categories was to the retail trade sector, followed by the household and construction sectors. This would indicate that the industry purchases large amounts of materials and uses a large workforce in completing its road construction activities. Construction expenditures should have been essentially for subcontracted work; this is a concern because it is possible some of these expenditures may be to other

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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, Leuthold [1975] and Pindyck and Rubinfeld [1981]).

TABLE 7. ESTIMATED ROAD CONSTRUCTION INDUSTRY LOCAL CONTRIBUTION EXPENDITURES BY ECONOMIC SECTOR FOR ESTIMATED CURRENT AND TWO HIGHER FUNDING SCENARIOS, 1985.

Sector	Estimated 1985	Scenario I	Scenario II
	thousand dollars		
Nonmetalic Mining	6,759	6,972	7,185
Construction	26,837	27,684	28,532
Transportation	2,473	2,553	2,633
Communications & Public Utilities	1,332	1,374	1,416
Wholesale & Misc. Manufacturing	11,827	12,199	12,572
Retail Trade	43,100	44,141	45,182
Finance, Insurance, Real Estate	5,857	6,043	6,229
Business & Personal Service	16,552	16,594	16,636
Professional & Social Service	845	872	898
Households	38,535	39,485	40,435
Total	154,117	157,917	161,718

firms completing the mail survey, and therefore create a double counting problem. It also is possible that there may have been some misunderstanding of the sector delineations such that some expenditures included in the construction sector may not have been for subcontracted construction, but rather for other construction expenses. Data were not available to resolve this situation so the subcontract construction expenditures were included in the analysis.

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 8). If the industry had been funded at the $5 and $10 million higher levels, personal income would have amounted to $134.6 million and $137.8 million, retail sales activity of $122.2 million and $125.2 million would have been realized, and $438.6 million and $449.3 million in total business activity would have been generated in 1985, respectively. Total economic contribution business activity was $427,854,000 and expenditures were $154,117,000 for the 1985 funding level, indicating that each dollar spent in the local economy generated another $1.78 for a total of $2.78. Expenditures and total business activity for the alternative funding scenarios produced similar results as they also generated $1.78 for a total of $2.78.

Tax Collections

Data in Table 8 provided the necessary measures of business activity to estimate tax revenue generated by the road construction industry. Categories

TABLE 8. ESTIMATED PERSONAL INCOME, RETAIL SALES, BUSINESS ACTIVITY OF ALL BUSINESS (NONAGRICULTURAL) SECTORS, AND TOTAL BUSINESS ACTIVITY FOR THE ROAD CONSTRUCTION INDUSTRY, FOR CURRENT AND TWO ALTERNATIVE FUNDING SCENARIOS, 1985

Item	Estimated 1985	Scenario I	Scenario II
	thousand dollars		
Personal Income	131,318	134,575	137,837
Retail Sales	119,294	122,236	125,182
Business Activity of all Business Sectors[a]	262,799	269,368	275,926
Total Business Activity	427,854	438,573	449,295

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

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 9). 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). Tax revenues associated with the two higher funding levels would have generated $8.6 million and $8.8 million, respectively. Sales and use tax collections also were the largest category for the higher funding scenarios.

Employment

Direct employment for the road construction industry is often measured in terms of peak workforce and full-time equivalents because of the seasonal nature of the work. 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

TABLE 9. ESTIMATED TAX REVENUES ASSOCIATED WITH THE ROAD CONSTRUCTION INDUSTRY FOR CURRENT AND TWO ALTERNATIVE FUNDING SCENARIOS, 1985

Tax	Current 1985	Scenario I	Scenario II
	thousand dollars		
Sales and Use	4,843	4,963	5,082
State Personal Income	2,758	2,826	2,895
State Corporate Income	815	835	855
Total	8,416	8,624	8,832

persons working on a 12 months-per-year basis. Full-time equivalent employment was determined from the information provided on the questionnaire administered to the road construction industry; results of a survey distributed by the Associated General Contractors established the 1985 peak workforce for the industry for the funding level that existed that year. (Associated General Contractors 1986).

Direct road construction employment in North Dakota was estimated to be 1,436 full-time equivalent workers with a peak workforce of 3,806 in 1985 (Table 10). As previously mentioned, these estimates of the direct workforce include only the workers employed by the private businesses in the industry (i.e., county, city, and township estimates of workers allocated to road and street work were not available). Industry expenditures also are responsible for creating secondary (indirect and induced) employment in North Dakota. Because not all the direct employment could be estimated, the secondary employment resulting from industry expenditures will be presented for the private businesses and for the industry total (i.e., private firms expenditures and those by the counties). Indirect and induced employment attributable to the private firms' expenditures amounted to 5,257 workers for the 1985 funding level and 5,426 and 5,592, respectively, for the alternative scenarios. These secondary employment figures should be used in conjunction with the previously described direct employment figures if employment multipliers are to be estimated. Secondary employment resulting from the industry's expenditures totaled 7,425 workers for the 1985 funding level and would have amounted to 7,594 and 7,760 workers for the alternative funding scenarios (Table 10).

The direct linear relationship that exists between the results for the 1985 funding level and the alternative scenarios allows the estimation of about 9 full-time equivalent direct jobs and 33 indirect and induced jobs for each $1 million of additional funding for the industry. Direct employment

TABLE 10. ESTIMATED DIRECT AND SECONDARY EMPLOYMENT ATTRIBUTABLE TO THE ROAD CONSTRUCTION INDUSTRY, FOR CURRENT AND TWO ALTERNATIVE FUNDING SCENARIOS, 1985

Employment	Current 1985	Scenario I	Scenario II
Direct - full-time equivalents	1,436	1,483	1,530
Direct - peak	3,806	3,929	4,053
Secondary - private businesss expenditures	5,257	5,426	5,592
Secondary - total expenditures	7 ,425	7,594	7,760

for the higher funding levels was calculated by adding the jobs created from the higher level of expenditures (based on the workers per contract volume from the mail survey responses) to the existing 1985 employment. 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 road construction industry. 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 road construction and maintenance industry has the responsibility to build and repair over 100,000 miles of the state's highways, roads, and streets. This industry is unique in that its method of financing is primarily through user-fees, taxes, and transfer payments. North Dakota's transportation system is especially important to the state's economy because of its rural nature; it serves as a means of transporting products to their final markets, linking people to the retail trade centers, and also provides a way for goods required by residents to be distributed within the state. The road construction industry contributes to the state's economy in yet another way, as expenditures made within the state contribute to the economy in the form of increased personal income, retail trade activity, and total business activity. Effects this industry has on the state's economy were analyzed for the 1985 level of funding and also to determine what the economic contribution would have been with two higher funding scenarios.

Estimated local expenditures by the road construction industry amounted to over $154 million for 1985. At this level of funding the industry would generate total business activity of almost $428 million, personal income of $131 million, and retail sales activity amounting to $119 million. If the industry had been funded at the $5 million and $10 million higher levels for 1985, total expenditures would have been almost $158 and $162 million, respectively. These higher levels of spending would have generated higher levels of business activity; as a result, personal income would have been $135 and $139 million, retail sales activity would have amounted to $122 and $125 million, and the total business activity would have reached the $439 and $449 million levels, respectively.

Benefits of the road construction industry also accrue to the state in the form of tax revenues, which were estimated to be $8.4 million for the 1985 funding level. Sales and use tax collections accounted for the largest portion (58 percent) of the total. If the industry had been funded at the two higher levels, tax collections would have been estimated to be $8.6 million and $8.8 million, respectively. Sales and use tax collections also constituted the largest share for these scenarios. In addition to the workers directly employed by the industry (1,436 full-time equivalents with a peak workforce of 3,806), secondary employment is generated as a result of the

industry's outlays. This indirect and induced employment associated with private firms' expenditures amounted to 5,257 jobs for the 1985 funding level, and the alternative scenarios would have created 5,426 and 5,592 jobs, respectively. Total industry expenditures created 7,425, 7,594 and 7,760 secondary jobs, respectively, for the three levels of spending.

By applying the multiplier process, whereby a dollar injected into the economy "turns over" and creates additional "new" dollars, the road construction industry creates an additional $1.78 of business activity for each original dollar. Thus, each original dollar injected into the economy plus the created $1.78 gives a total of $2.78 in total business activity.

The road 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). These key economic variables provide an indication of the contribution the road construction industry makes to the state's economy.

Appendix A

TABLE A1. STATEWIDE AVERAGE COST PER MILE FOR RURAL HIGHWAY CONSTRUCTION, NORTH DAKOTA, 1984

Type of Highway	Grade and Structures	Gravel Surface	Hard Surface	Total
	dollars per mile			
State highway:				
2 lanes interstate recycling project	300,000	--	550,000[a]	850,000
2 lanes added to existing 2 lane highway	280,000	--	200,400[b]	480,400[c]
2 lane 52' roadbed, 400 + ADT highway	260,000	--	231,000[b]	491,000
2 lane 38' roadbed, 50-400 ADT highway	150,000	17,000	112,700[b]	279,700
Widen shoulders and resurface	97,000	--	175,000[b]	272,000
County federal-aid secondary highway - 32' roadbed	60,000	15,000	100,000[b]	175,000
Township highway	9,000	2,600	--	11,600[d]

[a]10" recycled PCC
[b]Bituminous surface
[c]Cost includes widening and resurfacing of existing 2-lane highway
[d]Estimated

SOURCE: North Dakota State Highway Department 1986b

TABLE A2. STATEWIDE AVERAGE COST PER MILE FOR HIGHWAY MAINTENANCE, NORTH DAKOTA, 1984

Type of Highway	Average Cost
	- dollars/mile -
State highway:	
2 lane	3,478
4 lane	5,770
all types	3,791
County highway	1,410
Township highway	200[a]
City street in city size of:	
under 1,000 population	2,170
1,000-4,999 population	5,440
5,000 and over population	6,210
all sizes	3,560

aComputed from mileage used by State Treasurer for distributing Township Road funds.

SOURCE: North Dakota State Highway Department 1986b.

TABLE A3. ESTIMATED ANNUAL VEHICLE MILES OF TRAVEL ON ALL ROADS AND STREETS CLASSIFIED BY FUNCTIONAL HIGHWAY SYSTEM, NORTH DAKOTA, 1984

COUNTY	INTERSTATE	PRINCIPAL ARTERIAL	MINOR ARTERIAL	MAJOR COLLECTOR	MINOR COLLECTOR	LOCAL ROADS & STREETS	TOTAL
	thousands of miles						
ADAMS		9,582	3,778	5,369	2,331	6,702	27,762
BARNES	73,897	6,527	29,198	29,431	3,353	24,524	166,930
BENSON		23,085	18,530	14,830	2,594	13,819	72,858
BILLINGS	15,814	15,733	935	3,034	6,856	2,779	45,211
BOTTINEAU		14,929	21,507	28,434	3,330	23,360	91,560
BOWMAN		24,204		5,936	3,447	7,181	40,828
BURKE		9,343	6,608	11,549	3,185	11,549	42,234
BURLEIGH	73,654	91,700	60,792	74,657	4,748	60,225	365,776
CASS	214,982	96,540	127,973	105,747	5,555	105,747	656,544
CAVALIER			23,665	14,173	2,879	18,765	59,482
DICKEY		9,299	18,058	10,285	2,750	13,513	53,905
DIVIDE			14,732	7,234	1,647	12,735	36,348
DUNN			32,969	7,718	2,989	7,789	51,465
EDDY		8,302	5,072	5,705	1,184	7,522	27,785
EMMONS		12,093	4,469	7,753	3,286	13,004	40,605
FOSTER		10,534	11,350	5,681	1,330	8,082	36,977
GOLDEN VALLEY	15,280			10,143	2,669	6,769	34,861
GRAND FORKS	62,424	146,323	71,078	80,309	6,321	51,055	417,510
GRANT			16,771	4,426	2,709	10,536	34,442
GRIGGS			15,524	6,391	1,278	8,351	31,544
HETTINGER			17,067	5,136	2,650	10,162	35,015
KIDDER	41,165	5,234	15,507	7,114	2,489	10,514	82,023
LAMOURE		7,856	14,825	12,423	1,438	13,797	50,339
LOGAN			9,497	3,759	1,440	7,687	22,383
MCHENRY		45,773	9,834	13,677	4,380	17,985	91,649
MCINTOSH			14,310	5,318	2,307	9,422	31,357
MCKENZIE		58,767	46,867	14,190	6,906	15,334	142,064
MCLEAN		43,736	26,926	20,177	4,982	27,649	123,470
MERCER			15,955	20,186	3,823	13,682	84,646
MORTON	107,129	24,038	46,787	51,277	3,900	24,037	257,168
MOUNTRAIL		21,523	28,830	7,650	4,187	17,963	80,153
NELSON		18,654	16,191	8,451	2,300	13,720	59,316
OLIVER			15,469	5,788	1,036	4,722	27,015
PEMBINA	17,154		37,999	26,970	4,292	20,241	106,656
PIERCE		24,572	2,681	5,251	3,265	13,917	49,686
RAMSEY		46,651	27,003	19,349	2,805	19,234	115,042
RANSOM			17,688	7,716	2,938	12,540	40,882
RENVILLE		6,395	6,588	10,191	1,361	10,954	35,489
RICHLAND	34,577	18,245	39,301	25,846	8,278	30,003	156,250
ROLETTE		9,943	21,440	26,945	2,852	13,556	74,736
SARGENT			22,350	8,156	1,537	11,560	43,603
SHERIDAN		2,478	8,890	5,261	1,460	8,610	26,699
SIOUX			9,171	7,881	1,024	2,760	20,836
SLOPE		13,193	1,264	2,721	2,613	3,728	23,519
STARK	76,343	47,613	18,441	29,207	5,147	26,428	203,179
STEELE			14,422	10,215	2,208	9,961	36,806
STUTSMAN	77,345	53,026	24,049	34,152	4,752	28,047	221,371
TOWNER			17,917	6,779	2,579	10,906	38,181
TRAILL	47,394		18,790	23,400	3,621	21,294	114,499
WALSH	20,020	6,977	51,417	28,074	4,187	21,493	132,168
WARD		204,430	44,956	50,417	5,417	71,838	377,118
WELLS		21,265	18,349	11,595	2,327	13,983	67,519
WILLIAMS		83,927	28,420	38,367	12,001	35,405	198,120
TOTAL	877,178	1,242,490	1,223,270	992,504	180,943	987,199	5,503,584

SOURCE: North Dakota State Highway Department 1986b.

TABLE A4. FEDERAL-AID HIGHWAY PROGRAM USER FEES, 1985

User Fee Type	Rate
Gasoline	9¢/gallon
Gasohol	3¢/gallon
Diesel	15¢/gallon
Special Fuels	9¢/gallon
Tires	0-40 lb., no tax
	Over 40-70 lb., 15¢/lb. in excess of 40 lb.
	Over 70-90 lb., $4.50 + 30¢/lb. in excess of 70 lb.
Truck and trailer sales	12% of retailer's sales price for trucks over 33,000 lb. gross vehicle weight (gvw) and trailers over 26,000 lb. gvw.
Heavy vehicle use	Annual tax: Trucks 55,000 lb. gvw to 75,000 lb. gvw, $100 plus $22 for each 1,000 lb. (or fraction thereof) in excess of 55,000 lb.
	Trucks over 75,000 lb. gvw, $550

TABLE A5. TAXES LEVIED BY COUNTIES FOR ROAD PURPOSES, NORTH DAKOTA, 1985

County	County Road and Bridge	County F.A.S. Highways	Unorganized Township Road	Special County Highway Improvement	Sinking & Interest		Total Taxes Levied for Road Purposes
					County Loan	Bonds	
	dollars						
Adams	1,695.90	96,799.62	25,615.41			55,085.70	124,110.93
Barnes	100,072.21	425,995.49					581,153.40
Benson	3,537.35	138,755.55	2,681.81				144,974.71
Billings			137,137.39				137,137.39
Bottineau	54,419.06	180,959.78		92,119.02			327,497.86
Bowman	115,373.17		11,305.35				126,678.52
Burke	1,631.44	55,599.28	999.90				58,230.62
Burleigh	18,734.00		62,905.00				81,639.00
Cass	31,543.17	1,261,726.62					1,293,269.79
Cavalier	26,417.30	202,004.32		4,755.11			233,176.73
Dickey	120,230.51	150,177.86			36,074.05		306,482.42
Divide	43,303.17	96,831.78					140,134.95
Dunn	19,249.02	95,039.92	230,434.72				344,723.66
Eddy	7,186.78	73,132.22					80,319.00
Emmons	84,677.77	91,858.05	224,980.39	3,590.14			405,106.35
Foster		86,365.55		22,368.68			108,734.23
Golden Valley	1,857.72						16,508.45
Grand Forks	197,196.75	586,278.48	14,650.73				783,475.23
Grant	80,610.47	45,195.50	100,698.33				226,504.30
Griggs	45,518.90	87,314.25					132,833.15
Hettinger	2,804.62	81,334.08					84,138.70
Kidder	1,798.10	77,318.07	2,265.52				81,381.69
LaMoure	51,093.13	189,946.23			36,065.74		277,105.10
Logan		40,128.54	63,851.00				103,979.54
McHenry	6,028.08	135,054.57	17,598.99	27,960.02			186,641.66
McIntosh		150,020.73	137,047.19				287,067.92
McKenzie	353,628.68		122,251.79				475,880.47
McLean		175,190.18	82,042.81				257,232.99
Mercer	79,933.03	146,754.98	152,147.25				378,835.26
Morton	9,435.53	314,391.80	548,513.31				872,340.64
Mountrail	2,688.73	119,917.18	5,902.19				128,508.10
Nelson	23,604.40	70,604.31		55,982.12			150,190.83
Oliver	1,154.06	45,991.25	71,500.55				118,645.86
Pembina	22,387.76	223,877.62					246,265.38
Pierce	17,087.38	119,708.25	60,495.93				197,291.56
Ramsey	134,228.72	223,657.91					357,886.63
Ransom	63,978.70	118,802.36					182,781.06
Renville	35,010.64	64,025.37					99,036.01
Richland	157,669.05	314,148.16			90,436.59		562,253.80
Rolette	2,523.60	102,037.50	80,789.74				185,350.84
Sargent	12,678.47	92,543.91		46,271.54			151,493.92
Sheridan	9,545.22	62,855.75	43,982.02				116,382.99
Sioux			39,499.85	450.19			39,950.04
Slope			14,963.70				14,963.70
Stark	30,681.53		295,694.04				326,375.57
Steele	77,179.13	89,537.81		44,765.43	26,860.65		238,343.02
Stutsman	192,015.97	209,868.69	4,068.25				405,952.91
Towner	94,768.03	109,763.62			30,603.24		235,134.89
Traill	214,758.41	318,154.13			59,486.81		592,399.35
Walsh	110,798.79	417,350.65		140,993.38	36,335.86		705,478.68
Ward	16,083.22	680,444.06					696,527.28
Wells	136,295.99	69,613.45					205,909.44
Williams	449,698.18	370,171.82	3,587.75				823,457.75
Total	3,262,811.84	8,807,247.25	2,557,610.91	439,255.63	315,862.94	55,085.70	15,437,874.27

TABLE A6. COUNTY HIGHWAY DISTRIBUTION, NORTH DAKOTA, 1985

County	Amount
	-- dollars --
Adams	$143,438.88
Barnes	466,343.58
Benson	236,514.93
Billings	49,951.97
Bottineau	344,534.26
Bowman	180,062.69
Burke	165,268.71
Burleigh	1,343,514.51
Cass	1,743,317.64
Cavalier	289,010.69
Dickey	238,856.40
Divide	156,157.51
Dunn	172,297.74
Eddy	127,930.13
Emmons	216,165.60
Foster	168,559.05
Golden Valley	107,409.13
Grand Forks	1,133,537.62
Grant	168,647.91
Griggs	141,983.07
Hettinger	179,499.00
Kidder	143,620.53
LaMoure	255,309.97
Logan	133,885.40
McHenry	296,162.25
McIntosh	175,610.51
McKenzie	293,771.06
McLean	461,062.95
Mercer	414,035.87
Morton	673,664.23
Mountrail	295,138.45
Nelson	201,369.99
Oliver	88,660.50
Pembina	382,683.66
Pierce	208,267.73
Ramsey	415,147.11
Ransom	212,551.83
Renville	149,746.29
Richland	611,112.51
Rolette	304,011.94
Sargent	200,817.48
Sheridan	115,418.80
Sioux	70,500.41
Slope.	53,514.20
Stark	618,677.43
Steele	122,692.84
Stutsman	637,179.72
Towner	165,723.71
Traill	320,634.55
Walsh	540,484.65
Ward	1,425,708.44
Wells	265,635.15
Williams	779,020.18
Total	18,804,821.36

SOURCE: North Dakota State Highway Department 1986c.

TABLE A7. FEDERAL-AID SECONDARY ALLOTMENTS TO COUNTIES, NORTH DAKOTA, 1986

County	Amount
	-- dollars --
Adams	75,013
Barnes	170,391
Benson	130,762
Billings	37,600
Bottineau	143,165
Bowman	62,720
Burke	67,439
Burleigh	126,240
Cass	369,566
Cavalier	138,294
Dickey	109,886
Divide	83,104
Dunn	122,015
Eddy	53,985
Emmons	106,946
Foster	64,602
Golden Valley	51,360
Grand Forks	234,449
Grant	88,869
Griggs	67,737
Hettinger	82,762
Kidder	91,858
LaMoure	121,454
Logan	60,835
McHenry	136,141
McIntosh	85,667
McKenzie	119,360
McLean	174,649
Mercer	111,586
Morton	200,438
Mountrail	125,592
Nelson	80,200
Oliver	49,034
Pembina	131,728
Pierce	87,526
Ramsey	118,886
Ransom	92,101
Renville	68,550
Richland	163,154
Rolette	111,988
Sargent	90,005
Sheridan	66,979
Sioux	52,640
Slope	43,520
Stark	98,560
Steele	65,936
Stutsman	172,848
Towner	76,971
Traill	128,488
Walsh	177,284
Ward	276,537
Wells	107,050
Williams	175,529
Total	6,050,000

SOURCE: North Dakota State Highway Department 1986c.

TABLE A8. 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 A8. 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 A9. GROSS BUSINESS VOLUME TO EMPLOYMENT (PRODUCTIVITY) RATIOS, BY ECONOMIC SECTOR, NORTH DAKOTA, 1958-1984

Year	(1) & (2) Ag	(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) Households	(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	84,080	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	89,744	235,691	39,630	11,188	63,537	58,285	83,311	90,558	13,280	12,710	--	10,987	84,996	350,310	174,591	558,256

SOURCE: Coon et al. 1985.

TABLE A10. 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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