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Projecting Public Sector Effects of a New Industry in a Rural Area

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This paper presents a model for ex ante evaluation of the effect of new industry on public sector costs and revenues. The model employs input-output interdependence coefficients and cost and revenue estimators to evaluate total (direct, indirect, and induced) effects of new industry. Model application is demonstrated.

KEY WORDS: Fiscal impact analysis, rural industrialization, input-output

Projecting Public Sector Effects of a New Industry in a Rural Area*

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Rural communities often have sought to attract industry in the belief that it will produce an increase in public revenues. However, industrialization may be a fiscal detriment to local government if the revenues it produces are not as large as the additional public costs created by the industry and its resulting population increase. Garrison reports that the establishment of new manufacturing plants in five towns had a negative fiscal impact (i.e., additional public costs exceeded additional public revenues) on most local government units. Crowley finds that in-migrants to cities initially impose a net fiscal burden. Smith reports that overbuilding of public facilities in response to a major dam construction project led to substantial increases in public costs and tax rates in an Oregon community. On the other hand, Youde and Huettig estimate that establishment of a meat packing plant in a rural Oregon community would result in a positive fiscal impact (i.e., additional tax revenues exceed additional costs) on local government.

Most previous studies have failed to consider either all of the added service costs, all of the added revenues, or both. A common practice has been to consider the added revenue produced by the plant and compare this to the added service costs attributed to plant workers (Garrison, Loewenstein). This approach ignores tax revenues from worker's residences and other property. The secondary (indirect and induced) effects of industrial expansion also often have been ignored in previous studies, although there

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is evidence that these effects may be important in determining the overall net fiscal impact of a major new development (Hirsch). A recent study by Kee suggests that other important variables are the nature of the labor force (income and number of dependents per worker), nature of the industry (especially the capital-labor ratio), residential patterns of the work force (location and type of housing), and the incremental costs of school and other services required.

The purpose of this paper is to report on the development of a model for ex ante evaluation of the effect of a new industry on public sector costs and revenues. The model considers the direct effects of the new industry and also the indirect and induced effects. Application of the model is demonstrated, using the example of a coal gasification plant (several of which are proposed for construction in western North Dakota).

The Model

Adequate evaluation of a new industry's fiscal impact requires a model which reflects the interrelationships of business, household, and government sectors. The model developed in this paper employs an input-output interdependence coefficient matrix to trace sector interrelationships.

A second major feature of the model is the consideration of cost and revenue timing. When large developments are built in rural areas, a frequent problem is that public costs both for construction of new physical facilities and for more intensive operation of existing facilities increase immediately. However, increased public revenues to finance these facilities typically do not become available until some time after they are needed. This may create serious short-term difficulties for impacted communities (Gillmore and Duff).

The model has two major components--a set of regional input-output coefficients and a set of cost and revenue estimators.[1] The input-output model employed was derived from primary data collected by personal interview from firms and households in southwestern North Dakota. The model was developed by Sand and the coefficients were subsequently tested for validity by Senechal. The model has 13 sectors and is closed with respect to households.[2] The input-output model is used to estimate the indirect and income induced changes in business volume, employment, and income. These estimates provide the basis for calculating public sector costs and tax payments.

General Assumptions

1. Public sector revenues are computed using North Dakota's 1974 tax laws. All public revenues and costs are computed on the basis of 1972 prices.

2. Estimation of increased local gross business volume obtained through use of the interdependence coefficients of the input-output model assumes that the effects of the initial stimulus have had time to work themselves out.

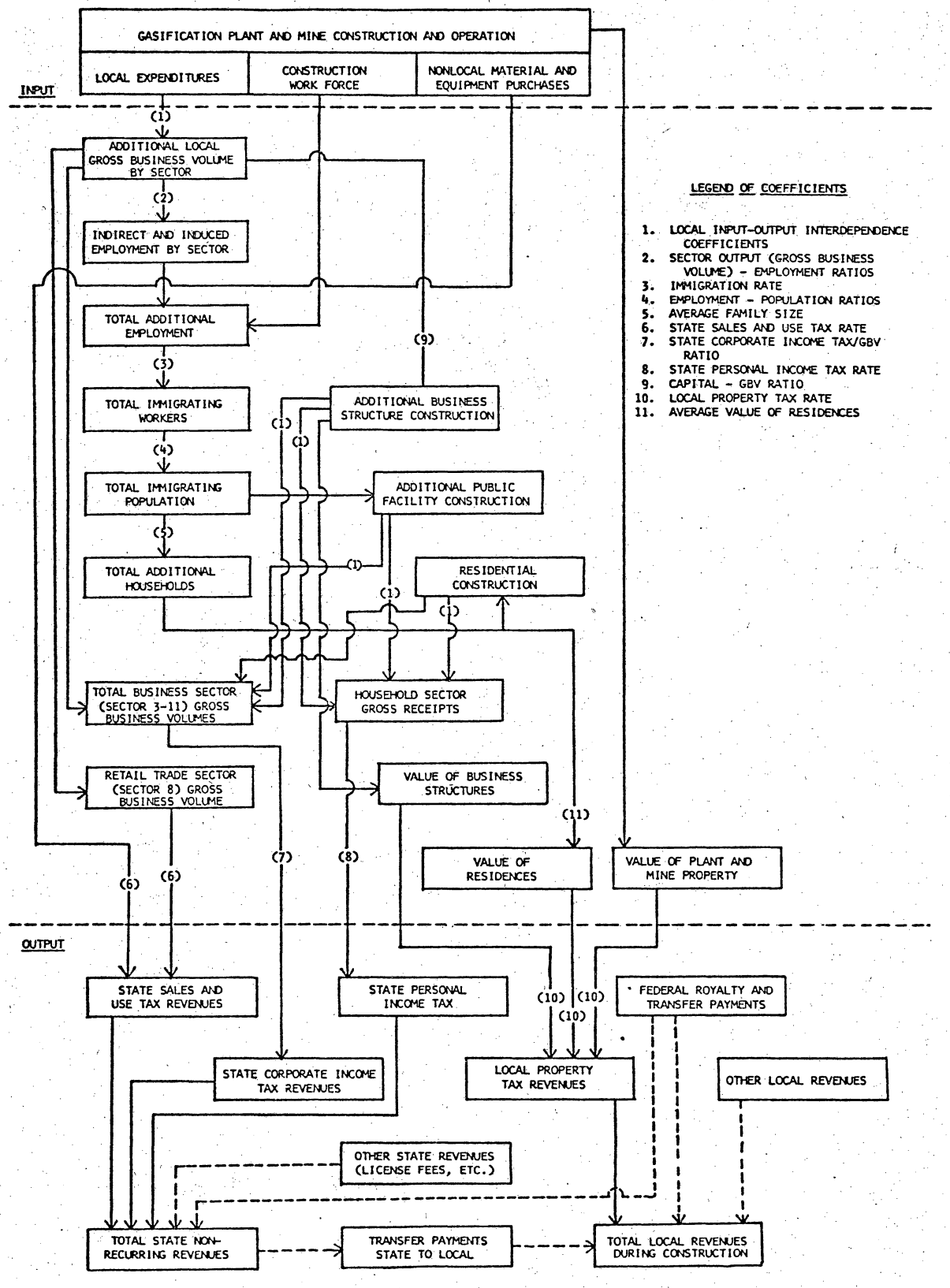
3. Added household revenues resulting from direct plant payroll and from indirect and induced effects represent a net gain to the state as new employees will either be in-migrants or persons presently unemployed or not in the labor force.

The Detailed Model

For greater ease of exposition, the model is divided into two submodels--one which relates the new industry to changes in public revenue and the other which relates it to changes in public costs.

The revenue submodel (Figure 1) begins with the initial economic stimulus provided by the operation of the plant. This direct stimulus occurs through local expenditures of the plant for labor, materials, and various services

FIGURE 1. FLOW CHART OF REVENUE ESTIMATION FOR A COAL GASIFICATION PLANT, NORTH DAKOTA, 1974*



*ASSUMES 1974 TAXATION POLICIES ARE IN EFFECT (ALL REVENUES ARE IN 1972 PRICES).
DASHED LINES (---) REPRESENT REVENUE FLOWS NOT ESTIMATED BUT INCLUDED FOR CONCEPTUAL COMPLETENESS.

and utilities. Local expenditures generate additional gross business volume in the local economy and the magnitude of the increase is estimated through use of input-output interdependence coefficients. These estimates of increased gross business volume of the various sectors are used in subsequent estimation of area employment, population, and tax base changes.

Additional employment (indirect and induced) is estimated for each economic sector except the household sector by dividing the increased gross business volume of the sector by the sector's ratio of gross business volume to employment. Estimates of the total additional employment (direct plus indirect and induced) resulting from the new plant's operation provide the basis for estimating the additional population of the area and the number of additional households. The number of additional households then provides the basis for estimates of increased residential property value.

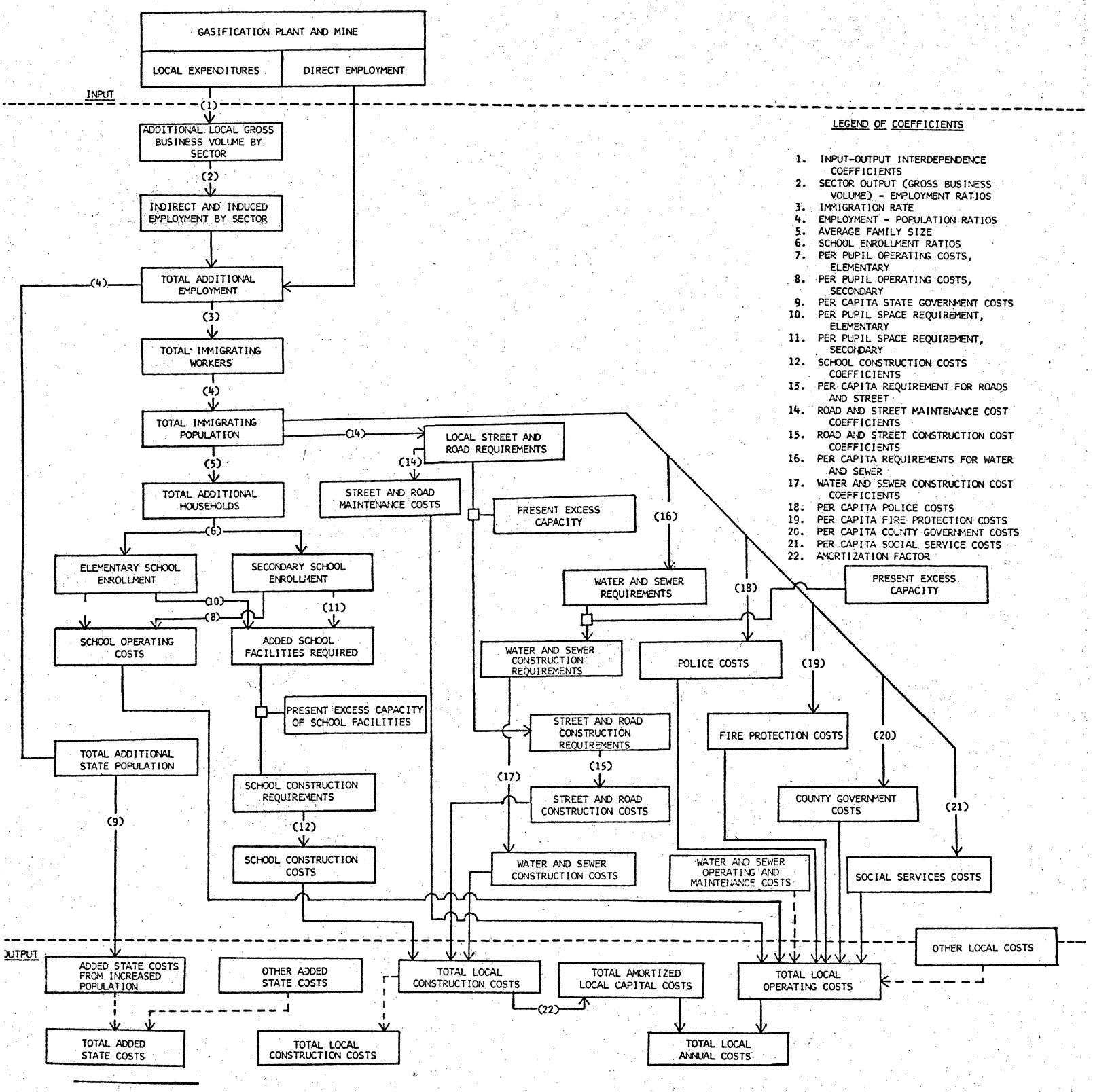
Revenues are estimated for both state and local levels of government. Under North Dakota's 1974 tax laws, state revenues came primarily from sales and use tax, personal income tax, and corporate income tax (Dorgan). State sales and use tax revenues are estimated by applying the sales tax rate to the additional gross business volume of the retail trade sector. Personal income tax receipts are estimated by applying the ratio (total state personal income tax collections ÷ total state personal income) to the added personal income (direct, indirect, and induced) resulting from plant operation. The change in gross receipts of the household sector is assumed to be equivalent to increased personal income. State corporate income tax revenue is estimated by applying the ratio (corporate income tax collections ÷ gross business volume of all nonfarm business sectors) to the total increased gross business volume of all nonfarm business sectors. Corporate income taxes collected directly from the new plant are estimated separately. Other state revenue sources include the vehicle fuel tax and various excise taxes and a portion of

royalty payments made by mining firms to the federal government. However, the revenues from these sources have not been estimated.

The principal source of local government revenues in North Dakota is the ad valorem property tax which accounted for more than 95 percent of all locally collected taxes in 1972 (Dorgan). The estimate of added property tax revenue is developed by applying the property tax rate to the taxable value of the new plant and its ancillary facilities and also to the value of added business and residential structures. Other sources of financial support for local governments include (a) other local tax collections including estate tax, (b) transfer payments from state government, and (c) transfer payments from federal sources. Transfer payments constitute a significant source of support, but estimation of the effects of a new industry upon the magnitude of these payments requires a complex set of assumptions. Consequently, while these payments are included in Figure 1 for conceptual completeness, their magnitude has not been estimated.

The cost submodel is shown in Figure 2. As in the revenue submodel, the initial stimulus provided by the new plant generates increases in gross business volume and increases in employment and population. Increased population, in turn, generates added demands on public services. Public costs increase at both state and local levels; however, the local cost increases are the area of greatest interest. Estimates of operation and maintenance costs of public services are based on the estimated population increase. Capital costs arising from the construction of new service facilities also are based on population increase, taking into account any excess capacity in present facilities. In many rural areas, existing excess capacity may be substantial in relation to increased needs; and, where this is the case, the effect on local costs and thus on the local net fiscal resources could be considerable.

FIGURE 2. FLOW CHART OF COST ESTIMATION FOR A COAL GASIFICATION PLANT, NORTH DAKOTA, 1974



DASHED LINES (---) REPRESENT REVENUE FLOWS NOT ESTIMATED BUT INCLUDED FOR CONCEPTUAL COMPLETENESS.

Model Application

The model was applied to the situation of a coal gasification plant to be located in western North Dakota. Mercer County, North Dakota, was the assumed site of the plant. The plant was expected to employ 625 full-time workers when in full operation and the mine to fuel it about 300. Construction of the plant was expected to take about three years with an average of 2,200 construction workers employed. Estimates of local expenditures developed by Dalsted were used as input for the model.

Revenue Determination

Added public revenues resulting from construction and operation of the new plant were estimated for both local and state government. Local revenues from property taxes were estimated, but local revenues from other sources were not. State revenues from sales and use tax, personal income tax, and corporate income tax were estimated, but state revenues from other sources (e.g., motor fuel tax, excise taxes, etc.) were not. A detailed discussion of the assumptions and data sources used in revenue estimation is provided by Leholm.

Cost Determination

Operating and maintenance costs were estimated for schools, streets, police and fire protection, county government (excluding county roads), and social service costs. The analysis assumed no excess capacity in public services in Mercer County. Capital costs were estimated for school facilities and streets. Operating and maintenance costs were based on historical costs for various services in North Dakota. Capital costs were based on engineering estimates of the cost of new facilities and were amortized over 20 years at 7 percent interest. A detailed discussion of all estimation procedures and data sources is provided by Prestgard. Costs for state general government functions were assumed to be constant per capita and the estimated increase in these costs was based on average per capita costs for the 1972 and 1973 fiscal years (Bureau of the Census).

Findings and Conclusions

Tax revenue, public cost, and net fiscal impact estimates for construction and operation of a coal gasification plant are presented for state government in Table 1 and for local government in Table 2.

TABLE 1. INCREASED REVENUES AND COSTS OF STATE GOVERNMENT RESULTING FROM CONSTRUCTION AND OPERATION OF ONE GASIFICATION PLANT, NORTH DAKOTA (1972 PRICES)

Item	Construction Phase ($1,000)	Operating Phase ($1,000)
"One-Time" Tax Revenues:[a]		
Total	24,309	---
Annual Average[b]	8,103	---
Annually Recurring Tax Revenues[c]	---	3,202
Annual State Government Costs	3,980	1,707
Net Fiscal Impact (revenues minus cash):		
Annual	4,123	1,495
Total[d]	12,369	44,850

[a]Includes personal income tax, corporate income tax, and sales and use tax receipts during construction phase and also income and sales tax from business structures and public facility construction for operating phase.
[b]Average for a three-year construction period.
[c]Includes sales and use tax, personal income tax, and corporate income tax.
[d]Assumes construction phase of three years and operation phase of 30 years.

State Fiscal Impact

State revenues were estimated to exceed state costs by more than $12 million during the construction period with sales and use tax on the materials and equipment for plant construction accounting for about 75 percent of the total revenue (Table 1). The net fiscal impact for state government was positive in the operation phase also, amounting to $1.5 million annually for a total of $45 million during the 30-year period of plant operation. Thus, increased state government revenues were estimated to exceed increased costs by more than $57 million over the lifetime of the plant. However, it should be noted that transfer payments were not included in the calculation of state fiscal impacts. In recent years, the state has

TABLE 2. NET FISCAL IMPACT ON LOCAL GOVERNMENT OF CONSTRUCTION AND OPERATION OF A COAL GASIFICATION PLANT BY YEAR, MERCER COUNTY, NORTH DAKOTA (1972 PRICES)

Year	Revenue[a]	Current Operating Cost[b]	Capital Improvements: Original Cost[c]	Capital Improvements: Repayment and Debt Service[d]	Fiscal Balance[e]: Current	Fiscal Balance[e]: Cumulative
	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)
Construction Phase[f]						
1	0	587	2,780	---	-587	-587
2	449	1,173	2,780	262	-986	-1,573
3	1,013	1,173	0	525	-685	-2,258
Operating Phase						
4	1,363	608	818	525	+230	-2,028
5	1,363	608	0	602	+153	-1,875
:						
10	1,363	608	0	602	+153	-1,110
:						
15	1,363	608	0	602	+153	-345
:						
20	1,363	608	0	602	+153	+420
:						
25	1,363	608	0	0	+755	+3,099
:						
30	1,363	608	0	0	+755	+6,874
:						
33	1,363	608	0	0	+755	+9,139

[a]Includes all local government (municipal, school district, and county) revenues from property tax collections.

[b]Includes operating and maintenance costs for schools, streets, fire and police protection, social services, and general government services.

[c]Major capital improvements are schools and streets. Capital improvement estimate for operation phase assumes that two-thirds of housing for operation phase workers is housing used in construction phase.

[d]Assumes that needed public facilities are constructed in first two years of construction period and first year of operation period. Repayment and debt service for a given facility begins the year after it is built with a 20-year repayment period and 7 percent interest.

[e]Fiscal balance is difference between current revenue and the sum of current operating cost and repayment and debt service payments.

[f]Construction phase revenue estimate is based on the assumption that one-half of taxable residences and business structures associated with the construction phase are built in year 1 (first taxed in year 2) and one-half in year 2 (first taxed in year 3) and also that 30 percent of taxable value of plant and mine is constructed in year 1 (first taxed in year 2) and 40 percent in year 2 (first taxed in year 3).

made substantial payments to school districts. If the allocation policies used in recent years were continued, state transfers to local schools would be increased by about $450,000 annually during the operation phase of the project. Even larger payments could be expected during the construction phase. Such transfer payments would reduce the net fiscal gain of state government and provide a corresponding increase in fiscal resources available to local government.

Local Fiscal Impacts

Local tax revenues were estimated to be much less than local costs during the period of plant construction (Table 2). The net fiscal impact was negative and exceeded $2 million at the end of the construction period.

During the operation period, the local fiscal situation was much improved because the entire taxable value of plant and related facilities was added to the tax base. In addition, residential property valuations increased substantially. The current net fiscal impact was estimated to be positive throughout the operating period and the cumulative net fiscal balance became positive in year 18. The overall net impact for the entire period of plant construction and operation was positive and equal to about $ 9 million. When the local government costs and revenues were discounted to present value using a 7 percent discount rate, the discounted fiscal impact for the entire period of construction and operation was about $0.7 million. The discounted cummulative fiscal balance became positive in year 27.

Summary

The net fiscal impact for state government was positive and quite substantial. The net impact for local government over the plant's assumed life of 30 years also was positive. However, the timing of revenues and costs is very important to local government as substantial negative impacts

occur during plant construction. Transfer payments from state or federal government or a prepayment of taxes by the gasification company are possible means for easing these short-run burdens on local government.

Footnotes

[1]In concept, the model is similar to one developed by Hirsch. However, while the Hirsch model considers only one governmental unit (the local school district), both state and local levels of government are incorporated in this model.

[2]The sectors are: (1)agriculture--livestock production; (2)agriculture--crop production; (3)mining; (4)contract construction; (5)transportation; (6)communications and public utilities; (7)agricultural processing and wholesaling; (8)retail trade; (9)finance, insurance, and real estate; (10)business and professional services; (11)personal and social services; (12)households; and (13)government.

References

Crowley, R. W., "An Empirical Investigation of Some Local Public Costs of In-Migration to Cities," The Journal of Human Resources, 5:1 (1970), pp. 11-23.

Bureau of the Census, State Government Finances in 1972, U.S. Government Printing Office, Washington, D.C., 1973.

Dalsted, N. L., et al., Economic Impact of Alternative Energy Development Patterns in North Dakota, report prepared for Northern Great Plains Resources Program, North Dakota State University, Fargo, North Dakota, 1974.

Dorgan, B. L., Interim Annual Report of the Tax Commissioner of the State of North Dakota to the Governor and Legislature for the One-Year Period, July 1, 1972, to June 30, 1973, Office of the Tax Commissioner, Bismarck, North Dakota, 1973.

Garrison, C. B., The Impact of New Industry on Local Government Finances in Five Small Towns in Kentucky, Agricultural Economics Report No. 191, U.S. Department of Agriculture, Economic Research Service, Washington, D.C., 1970.

Gilmore, J. S., and M. K. Duff, The Sweetwater County Boom: A Challenge to Growth Management, University of Denver Research Institute, Denver, Colorado, 1974

Hirsch, W. Z., "Fiscal Impact of Industrialization on Local Schools," Review of Economics and Statistics, 46 (1964), pp. 191-199.

Kee, W. S., "Industrial Development and Its Impact on Local Finance," Quarterly Review of Economics and Business, 8:3 (1968), pp. 19-24.

Leholm, Arlen G., et al., Local Impacts of Energy Resources Development in the Northern Great Plains, report prepared for Northern Great Plains Resources Program, North Dakota State University, Fargo, North Dakota, 1974.

Loewenstein, L. K., "The Impact of New Industry on the Fiscal Revenues and Expenditures of Suburban Communities," National Tax Journal, 16:2 (1963), pp. 113-129.

Prestgard, P. G., Effect of Coal Development on Public Costs and Revenues in North Dakota, unpublished M.S. thesis, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, 1974.

Sand, L. D., Analysis of Effects of Income Change on Intersectoral and Intercommunity Structure, unpublished M.S. thesis, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, 1966.

Senechal, D. M., Analysis of Validity of North Dakota Input-Output Models, unpublished M.S. thesis, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, 1971.

Smith, C. L., T. C. Hogg, and M. J. Regan, "Economic Development: Panacea or Perplexity for Rural Areas," Rural Sociology, 36:2 (1971), pp. 173-186.

Youde, James, and Gerald Huettig, "Economic Impacts of a Proposed Beef Packing Plant on the Development of a Rural Central Oregon Community," Proceedings, 1971 Annual Meeting, Western Agricultural Economics Association, 1971, pp. 157-160.