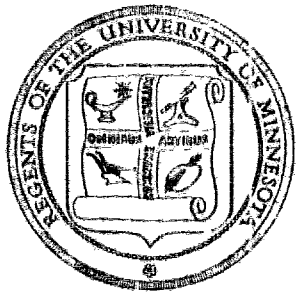
Staff Papers Series

P81-13 June 1981

STATEWIDE ECONOMIC AND FISCAL EFFECTS OF THE DIRECT REDUCTION OF IRON ORE TO STEEL IN NORTHEAST MINNESOTA

Wilbur R. Maki

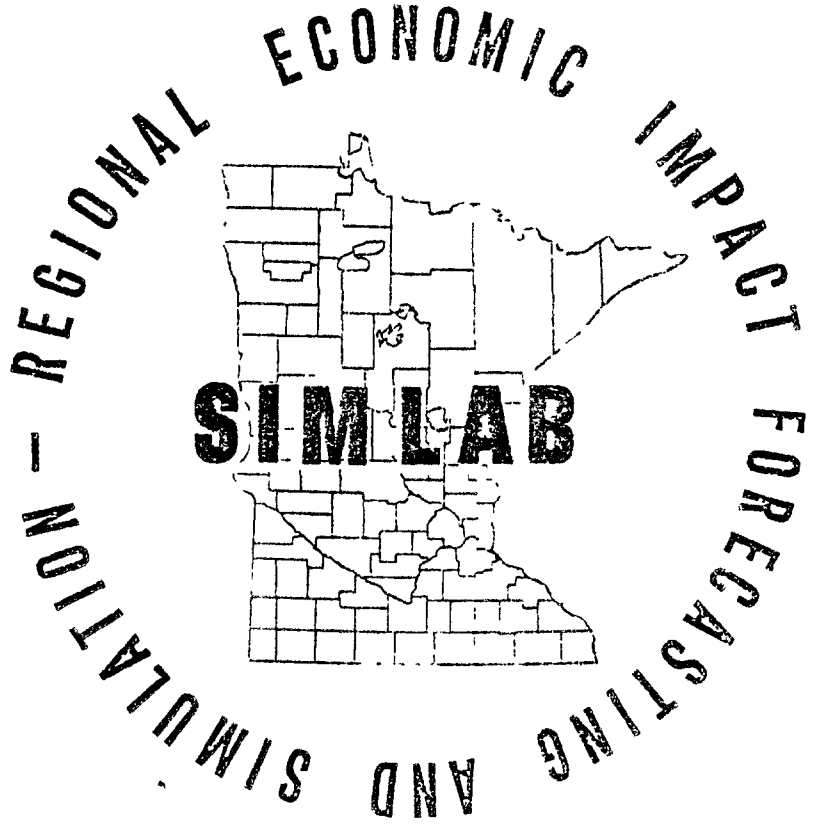


Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

STATEWIDE ECONOMIC AND FISCAL EFFECTS OF THE DIRECT REDUCTION OF IRON ORE TO STEEL IN NORTHEAST MINNESOTA

Wilbur R. Maki



REIFS Report No. 20

June 1981

CONTENTS

Acknowledgements

I am indebted to Mason Chen and Peter Stenberg for the computer programs and related data assistance in preparing this report and to the Minnesota Mineral Resources Research Center and the Minnesota Agricultural Experiment Station for their funding of this study and the related studies on which this report is based.

Abstract

The Minnesota Regional Development Simulation Laboratory (SIMLAB) was used to simulate statewide economic effects of three iron mining industry options -- revitalization of the Lower Great Lakes states steel industry, gradual liquidation of this industry, and the direct reduction of iron ore to steel in Northeast Minnesota. Industry output, employment, and value added indicators for the 1970 and 1977 years are compared with corresponding economic indicators for the 1980-2000 projection period. Finally, mineral-related state tax revenue trends are presented. Changes in these trends which are associated with each of the three iron mining industry options are projected for the 1980-89 period.

Summary and Conclusions

Taconite is joined with timber and tourism as the economic base of Northeast Minnesota. Of the three, taconite is still first. Nearly one of every two employed persons depends, directly or indirectly, on the taconite industry. This dependence is not one on one, nor is it easily traced, but it nonetheless exists because of the basic, or first, dollar the industry brings to the Northeast Minnesota economy.

The iron mining industry in Northeast Minnesota entered the 1980's with a much-improved capacity for growth and competition because of recent large capital expenditures in new plant and equipment. These investments signaled confidence in the future of the industry by its management and owners.

While the capacity to produce iron ore and taconite in Northeast Minnesota was increasing, the capacity of the U.S. steel industry to compete in steel making was declining, particularly in the Lower Lakes states of Illinois, Indiana, Michigan and Ohio. Decline of steel making in the four Lower Lakes states translates immediately into a decline in the demand for Northeast Minnesota iron ore and taconite. A revitalization of the Lower Lakes states steel industry would be essential to protect this market for Northeast Minnesota taconite producers.

Industry reviatlization is not the only viable alternative for the managers and owners of the Lower Lake states steel industry: they can choose to gradually, or even suddenly, liquidate this industry, given the intense competition it faces on the one hand and, on the other, the opportunities available to employ accessible capital resources more profitably elsewhere in the economy. Industry liquidation is an alternative option facing Northeast Minnesota iron mines and taconite producers.

A third industry option is the direct reduction of iron ore to steel (DRI) in Northeast Minnesota. This option, when compared with the industry revitalization option, is second best. It is better, nonetheless, in terms of industry output, employment and value added, and their local consequences in social and economic improvements, than industry liquidation.

This report addresses the statewide economic and fiscal implications of the three industry options. It starts with the worst case first -- industry liquidation. Under this option, the 1980 iron ore and taconite production of approximately 50 million tons would increase only slightly -- to 50.9 million tons by 1985 -- and it would then gradually decline.

The DRI development option provides for modest growth in the demand for taconite pellets with the introduction of a new steel industry in Northeast Minnesota. This industry would start small, growing gradually. In this report, the DRI development option represents, at best, a market expansion of less than 20 percent of the 1980 taconite production level.

The industry revitalization option is the more promising of the two growth options, but it is also more dependent on national economic conditions and policies. Under this option, the iron mining industry in Northeast Minnesota would produce 78.6 million tons of taconite by the year 2000 -- a 57 percent production increase in 20 years.

The economic effects of taconite industry development were projected with the University of Minnesota Regional Development Simulation Laboratory (SIMLAB) from 1970 and 1977 to 2000. All projected values were derived in constant 1970 dollars for a 54-industry breakdown of the private-sector (i.e., all industry except general government) of the Minnesota economy.

For the two base years, selected industry indicators were estimated as follows:

Indicator	Iron Mining	All Industry	Min. Ind. as % of All Ind.
Estimated 1970:			
Gross output (in mil. 1970 $)	571.4	37,975.8	1.5
Value added (in mil. 1970 $)	329.8	19,452.7	1.7
Employment (in thousands)	13.2	1,398.3	0.9
Estimated 1977:			
Gross output (in mil. 1970 $)	572.2	45,698.9	1.3
Earnings (in mil. 1970 $)	126.7	12,427.5	1.0
Employment (in thousands)	13.9	1,663.3	0.8

The iron mining industry accounted for 1.5 percent or less of all industry activity in Minnesota in 1970 and 1977. In Northeast Minnesota, which accounts for about 15 percent of Minnesota employment, the iron mining industry is an important part of the region's export-producing sector. Because of its role as a basic industry, the long-run effects of iron mining industry growth and decline are much larger than indicated by its output, income and employment, or even its input-output multipliers, which depict only short-run effects of changes in one industry on all industries. Decline of the iron mining industry to only 80 percent of its current production capacity of 66 million tons would reduce total employment by 20,000 and gross state product by $600 million, in 1970 dollars, or by more than $1 billion, in current dollars.

In 1979, the iron mining industry in Minnesota reached its peak year with 60 million tons of iron ore and taconite production. By 1980, iron ore production had dropped to 45.2 million tons -- about 20 million tons below current industry capacity.

Statewide impacts of these trends are reported for the three industry options for the year 2000. The economic effects associated with different levels of iron mining industry production are measured in terms of all industry output, value added and employment. These statewide effects are summarized as follows:

Indicator	Industry Liquidation	DRI Development	Industry Revitalization
Iron Mining:			
Gross output (in mil. 1970 $)	455.5	522.3	785.8
Value added (in mil. 1970 $)	262.7	318.6	453.5
Employment (in thousands)	5.2	6.3	9.1
All Industry:			
Gross output (in mil. 1970 $)	79,348.8	79,668.0	80,439.1
Value added (in mil. 1970 $)	41,563.3	41,733.9	42,179.1
Employment (in thousands)	1,744.2	1,749.8	1,763.4

In the projected year 2000 Minnesota economy, the iron mining industry would account for less than one percent of all economic activity. This representation of the industry severely distorst its full economic role and importance in Minnesota. Because of the basic industry role of iron mining, its multiplier effect would result in a total impact more than three times its direct impact. The large long-run multiplier makes the iron mining industry an important factor in the region in which the industry is concentrated, specifically, Northeast Minnesota.

The Minnesota economy was simulated to the year 2000 wth the three industry options with respect to a fourth option, namely, the maintenance of 1980 iron ore and taconite production levels. If the 1980 iron ore and taconite production of approximately 50 million tons were fixed over the 20-year period to the year 2000, the three industry options would compare as follows:

Indicator	Industry Liquidation	DRI Development	Industry Revitalization
Iron Mining:			
Gross output (in mil. 1970 $)	-150.4	162.8	940.5
Value added (in mil. 1970 $)	-80.4	90.2	502.4
Employment (in thousands)	-2.7	2.9	16.6
All Industry:			
Gross output (in mil. 1970 $)	-45.6	51.2	285.0
Value added (in mil. 1970 $)	-26.3	29.6	164.5
Employment (in thousands)	-0.5	0.6	3.3

Thus, the industry liquidation option would significantly reduce all levels of economic activity below those supported by the fixed iron mining option (of 50 million tons annually).

The DRI development option would result in overall economic expansion of $162.8 million in gross output, $90.2 million in value added and 2.9 thousand in employment simply as a result of the expansion of taconite production. The DRI development itself may double these projections. The corresponding figures for the industry revitalization option would still keep that industry more than twice as large as the combined taconite production and DRI.

The DRI development option is a "fall-back" position to the preferred industry revitalization option. It offers significant economic gains over the industry liquidation option insofar as it provides an added market for taconite pellets.

The statewide fiscal effects of the three industry options were measured with reference to the mineral-related tax collected from the iron mining industry in the 10 years from 1970 to 1979. During this period, total mineral-related tax revenues were $515.6 million. Of this total, local governments received $388.4 million, or 75.3 percent of the total, and state government received $127.2 million, or 24.7 percent of the total.

Total mineral-related taxes collected from the iron mining industry increased from $18.4 million in 1970 to $111.8 million in 1979. During the same period total state and local tax revenues increased from $1.9 billion to $4.7 billion, while property tax and corporate net income tax revenues increased from $80 million to $381 million. Thus, the mineral-related tax revenues increased by more than 500 percent as compared with a 142 percent increase in total state and local tax revenues and a 376 percent increase

in property and corporate net income tax revenues.

Mineral-related taxes in Minnesota are levied in lieu of property and corporate net income taxes and include three principal types of severance and tonnage taxes -- the occupation tax, which is levied on the market value of gross receipts from iron ore and taconite production in lieu of corporate net income tax, a royalty tax which is levied on royalties paid by the iron mining industry, and a production tax,which is levied on tonnage in lieu of a property tax. Growth in the three mineral-related taxes is compared with growth of property and corporate net income taxes for the 1970-79 period, as follows:

State & Local Rev. Source	1970-71	1975-76	1976-77	1977-78	1978-79	1979-80
			(million dollars)			
Iron Mining-Related Taxes	18.4	58.2	59.7	61.0	104.3	111.8
Property Taxes	818	1,006	1,075	1,202	1,260	1,439
Corp. Net Inc. Taxes	80	196	258	293	357	381

More and more of the total mineral-related tax revenues is being derived from the newest of the three taxes, the production tax, as shown below:

	Estimated		Projected (Liquid. Option)	
Type of Tax	1970-74	1975-79	1981-84	1985-89
Production	30.3	67.6	78.8	81.7
Occupation	59.2	27.0	17.6	15.8
Royalty	10.5	5.4	3.5	3.2
Total	100.0	100.0	100.0	100.0

The statewide fiscal effects of the three industry options also were projected for the ten years from 1980 to 1989. These projections were based on an assumed five-percent annual increase in the taconite pellet price index, starting with the 1980 prices. The mining tax revenues and their distribution for the 1980-89 period (in millions of current dollars) were projected as follows:

Type of Government	Estimated-1970-79	Projected, 1980-89 Industry Liquidation	DRI Development	Industry Revitalization
		(million dollars)		
Municipalities & Counties	81.0	173.0	174.2	274.2
School Districts	139.8	236.6	230.6	318.4
Property Tax Relief	69.1	129.1	130.7	173.3
Economic & Environ.	97.0	655.8	661.0	899.7
State Government	127.2	176.0	178.5	241.9
Total	515.6	1,370.5	1,390.1	1,865.4

The projected mining tax revenues are more than twice the 1970-79 total for two of the three industry options and more than three times for the third option. The iron mining industry is an increasingly important source of state and local government income -- a trend started in the '70's and sustained in the '80's, according to these projections.

Of the four types of local government, the largest increases in tax revenues are projected for the two trust funds set up by the Minnesota legislature to provide for mining area economic and environmental protection and rehabilitation. The two funds receive the residual tax revenue per taxable ton of iron ore and tacnoite after other local governments have received their pre-assigned shares. As the taconite price index on which the production tax rate is based increases, so does the residual share received by the two funds. Both funds are administered by the Iron Range Resources and Rehabilitation Board. Altogether, mineral-related tax revenues received by the three entities of local government are projected to increase from $97 million in the 1970-79 period to more than $655 million in the 1980-89 period.

STATEWIDE ECONOMIC AND FISCAL EFFECTS OF THE DIRECT REDUCTION OF IRON ORE TO STEEL IN NORTHEAST MINNESOTA

Wilbur R. Maki

The direct reduction of iron ore to steel (DRI) is a potential new technology that may provide an important boost to the Minnesota taconite mining industry. While taconite mining is only one of 10 mineral-related industry groups in the state -- an industry group which accounts for only two percent of total employment and payroll in Minnesota -- it contributes a substantially larger share of the state's tax revenue than many other industry groups (6, 7).[1/] Its long-term impact on the state's economy also is much larger than indicated by its employment and payroll share.

The location of Minnesota taconite and natural iron ores mining is shown in Figure 1.1. The three iron ranges -- Cayuna, Mesabi, and Vermillion -- are identified, along with the individual counties in the Northeast Minnesota taconite area. The seven counties -- Aitkin, Carlton, Cook, Itasca, Koochiching, Lake and St. Louis -- belong, also, in the Arrowhead Development and Planning District. Douglas County, Wisconsin is included with the Arrowhead District in the Northeast Minnesota Study Region in the companion study (8).

Taconite mining is now concentrated on the Mesabi Iron Range. This means, as other studies in the DRI project show, that the direct reduction of taconite pellets into steel would likely occur near existing mining and processing sites or near existing steel mills. Hence, much of the economic impact of DRI development in Minnesota would occur in Northeast Minnesota within the commuting areas of the taconite industry-related work force.

What is DRI?

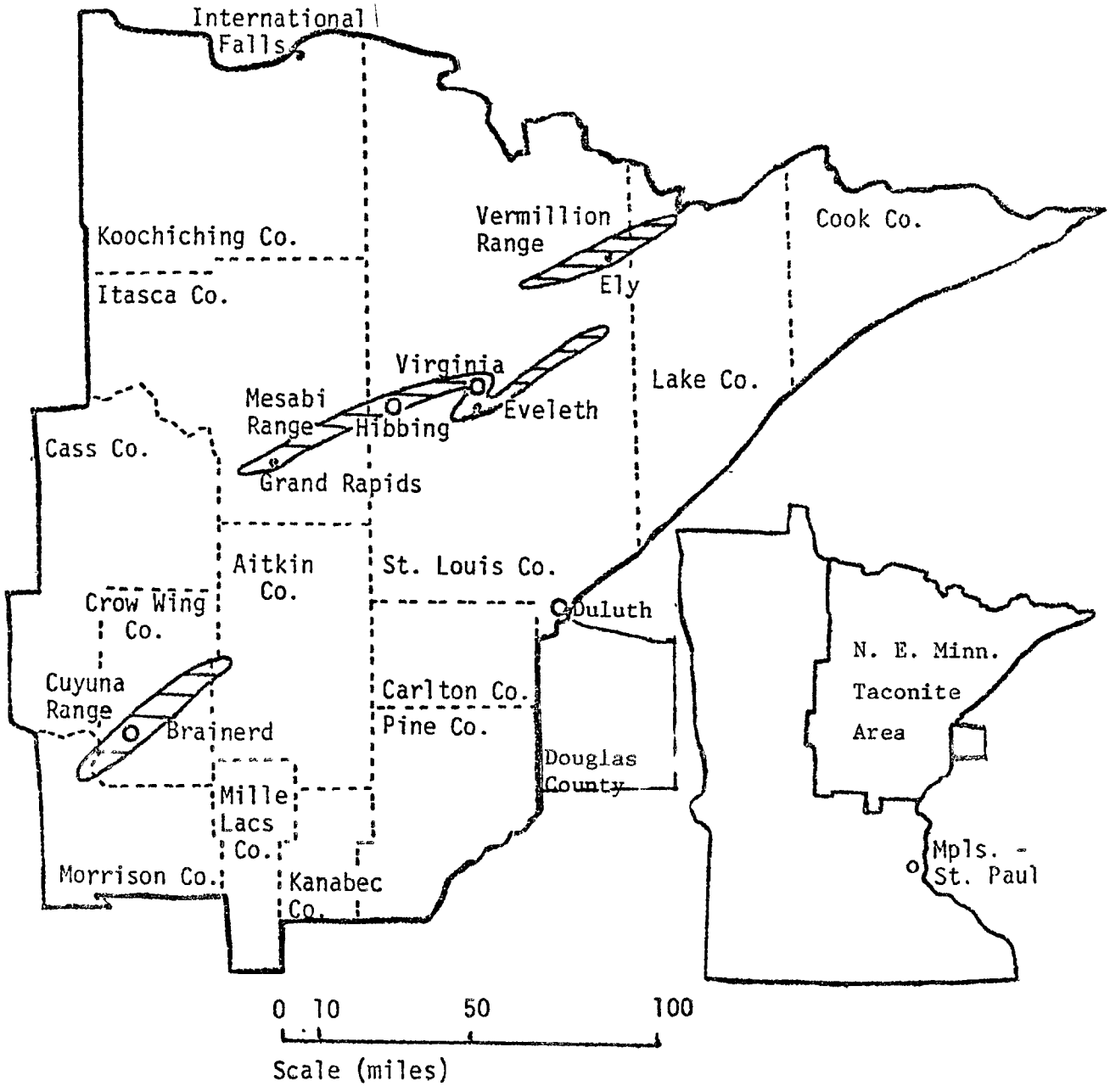
The direct reduction of taconite pellets into steel ingots is only

---

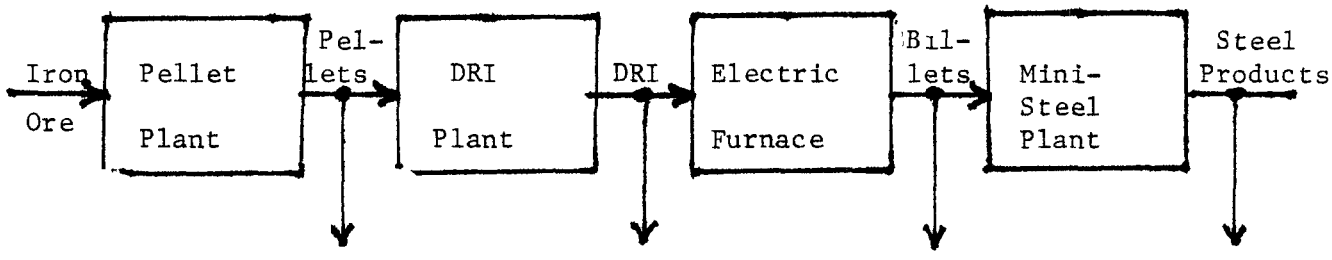
1/ Numbers in parentheses refer to references cited on p. 30.

Figure 1.1

Counties and Principal Incorporated Places in Northeast Minnesota Taconite Area



one stage in the conversion of iron ores into steel products. The entire process can be represented schematically, as follows:



Lower Lakes Market for Pellets (62% iron, 80¢ per iron unit or $50 per ton iron ore)	Lower Lakes Market for DRI (92% iron, ($135 per ton iron)	Lower Lakes Market for Billets ($200 to $1,000 per ton)	Upper Midwest Market for Steel Products ($300 to $1,000 per ton)

Thus, the DRI process makes possible the geographic separation of existing steel-making activities. The DRI plant may be located near the taconite plant or near an electric furnace or at an intermediate site. Each of the three processes is highly energy-intensive and, hence, access to an abundant source of energy is critical.

The value of steel products increases, as does its cost of storage and shipment, with each step in the steel making process. Thus, the stages of production closer to the finished products are more likely to locate in large market areas than near the iron mining. While one or more DRI plants may be built in Northeast Minnesota, an electric furnace in this area would be less likely, unless energy and, also, labor and transportation costs were favorable relative to market-oriented sites in the entire Midwest Region. A mini-steel plant, because of the increased bulkiness of product and greater need for quick and easy market access, it the least likely to be located near the iron mining.

Industry Growth Assumptions

Taconite industry growth assumptions for this report are based on three principal strategies -- Lower Lakes states steel industry liquidation, DRI development, and Lower Lakes states industry revitalization. The industry demand and supply assumptions for the liquidation option, which are presented in the companion report cited earlier, are reproduced in Table 1.1 (8,9). These assumptions show a declining market share for both U.S. steel production and U.S. taconite production. Imports of both steel and iron ores are projected to increase more rapidly than the demand for steel. Minnesota's share of U.S. projected iron ore production would remain constant (at 64 percent).

The liquidation option, when compared with earlier baseline forecasts of gradual growth in the demand for Minnesota taconite due to a revitalized Lower Lakes states steel industry, shows 33,062,500 tons of taconite by year 2000. The liquidation option implies, therefore, an immediate curtailment of existing taconite industry expansion trends and an actual reduction in total taconite production. Thus, the industry growth anticipated in the 1970's for the 1980's and 1990's would not occur.

The DRI development scenario provides for increases in steel and taconite shipments and production, relative to the liquidation strategy, as follows:

Item	1980	1985	1990	2000
		(million tons)		
Taconite Production	50.08	51.05	51.28	55.20
Steel Production	0.00	0.10	2.00	6.00
Taconite & Steel Shipments	50.08	50.99	50.05	51.52

The projected steel production of six million tons by year 2000 would be equivalent to an increase in taconite production of 9.68 million tons from its 1980 level of 50.08 million tons. However, the DRI development would

Table 1.1

Domestic Steel Demand and Iron Production Under Liquidation Strategy, U.S. and Minnesota, 1980-2000.

Item	Estimated [1] 1980	Projected 1985	1990	2000
	(millions of short tons)			
Raw Steel [2]	93.6	118	128	151
Net Imports Steel	9.6	17.7	25.6	45.3
Domestic Shipments	84.0	110.3	102.4	105.7
Net Imports Ore [3]	14.08 [4]	25.39	29.76	34.66
U.S. Iron Ore Production (iron content)	48.52	49.28	46.55	44.10
Minnesota Iron Ore Production (iron content)	31.05	31.55	29.79	28.22
Shipments of Minnesota Iron Ores (62% iron)	50.08	50.89	48.05	45.52

1/ Bureau of Mines, United States Department of Interior, Minerals and Materials/A Monthly Survey, Washington, D.C., Bureau of Mines, December, 1980. Table 8, Iron and Steel.

2/ Demand = Total Consumption = Domestic Shipments - Exports + Imports. Plus or minus 4 percent from Congress of United States Office of Technological Assessment, Technology and Steel Competitiveness. (Washington, D.C., U.S. Government Printing Office, June, 1980). Figure 7, Range of Projection Domestic Demand for Steel 1980-90, p. 16. Table 66, U.S. Steel Demand and Capacity, Comparison of Various Forecast, 1980-2000, p. 180.

3/ Estimate import under Liquidation Strategy of 15%, 1985; 20%, 1990; 30%, 2000.

4/ Bureau of Mining, Op. Cit., p. 33, Table 7, Currently Imported.

not replace the loss in market demand projected under the industry liquidation option.

Plan of Report

In this report, the statewide effects of possible DRI development in Northeast Minnesota are discussed and related to realier reports on the economic and fiscal effects of mineral-related industry in Minnesota (1,4,5,6, 7). The focus of this report, therefore, is not only on statewide economic and fiscal effects of possible DRI development in Northeast Minnesota, but, also, the statewide economic and fiscal effects of the decline in taconite mining projected in the liquidation strategy in the companion report cited earlier (8). The projected decline in taconite mining is related, however, to data in the earlier statewide studies. This makes possible comparisons between old and new baseline forecasts and their individual industry implications.

The statewide economic and fiscal effects of DRI development in Northeast Minnesota are presented under two headings -- statewide economic effects and statewide fiscal effects. Under the first heading, the current baseline projection is compared with the earlier baseline projection and the statewide industry implications of the industry liquidation strategy are discussed. This is followed by a discussion of the DRI development impact projection and its economic impact on individual industries in the state. Under the second heading, the corresponding fiscal effects of the industry liquidation strategy and the DRI development impact are discussed.

STATEWIDE ECONOMIC IMPACT

Statewide economic impacts of the Lower Lakes states industry liquidation and revitalization and DRI development options are presented here with reference to the 54-industry breakdown of the Minnesota economy shown in Table 2.1. Because all dollar values are reported in constant 1970 dollars, the 1970 base year is used also in this report for later comparisons with 1977 and year 2000 industry output, value added and employment levels for the three options. This series differs from the industry projection series in the companion report cited earlier.[2/] The related series is based on a 75-industry, rather than 54-industry, breakdown of the Minnesota economy and, also, on a more recent set of U.S. economic projections, which differ slightly from the earlier series (10,11). Because the 54-industry projection series allows direct reference to the earlier statewide projections, individual industry implications of the new steel and taconite industry assumptions can be readily documented.

Data presented here show that the iron mining industry,even under the industry revitalization option, as declining in importance in employment and gross output, relative to state totals, is summarized below:

Item	1970	1977	2000 (ind. revital.)
	(percent of state total or average)		
Employment	0.941	0.837	0.516
Gross Output:			
Total	1.505	1.252	0.977
Per Worker	160.0	149.6	189.2

In output per worker, however, the taconite industry is projected to increase relative to state averages, following a period of decline in the 1970's.

2/ Taconite industry output is adjusted to reported employment and payroll levels rather than actual production which was abnormally low because of a strike.

Table 2.1

Minnesota Industry Employment, Earnings, and Output (in 1970 dollars), 1977. 1/

Industry No	Industry Title	Employment	Earnings Total	Earnings Per Worker	Gross Output Total	Gross Output Per Worker
		(number)	(thou $)	($)	(thou.$)	($)
1.	Livestock	64,586	380,750	5,895	2,473,376	38,294
2.	Other Ag. Prod.	67,146	359,218	5,350	1,276,735	19,014
3.	Ag Serv.,For.,Fish.	4,259	31,721	7,448	58,276	13,683
4.	Iron Ores	13,924	126,735	9,102	572,197	41,094
5.	Other Metal Ore	550	5,032	9,149	42,111	78,565
6.	Copper Ore	0	0	0	0	0
7.	Non-Metal Mining	1,678	22,773	13,572	76,161	45,388
8.	Construction	85,540	932,825	10,905	2,651,547	30,998
9.	Ordnance	9,216	78,796	8,550	454,241	49,299
10.	Food & Kindred,exc	23,695	243,377	10,217	2,127,959	89,806
11.	Meat Products	17,079	173,557	10,162	2,044,833	119,728
12.	Grain Mill Prod.	4,108	59,769	14,549	710,062	172,849
13.	Beverages	4,685	47,922	10,229	368,019	78,553
14.	Apparel & Textiles	9,927	57,605	5,803	232,233	23,394
15.	Logging	1,844	11,512	820	99,466	53,940
16.	Wood Products	9,805	73,331	7,479	277,571	28,309
17	Paper Products	30,957	330,628	10,680	1,498,390	48,402
18.	Printing, Publ.	29,886	294,881	9,867	805,731	26,960
19.	Chemicals	6,323	61,901	9,790	527,783	83,470
20.	Petroleum & Related	1,722	24,897	14,458	315,847	183,419
21.	Rubber & Plastic	12,877	82,039	6,371	929,561	72,188
22.	Stone, Clay,Glass	9,135	81,532	8,925	259,431	28,400
23.	Primary Iron	3,528	30,583	8,669	179,525	50,886
24.	Primary Copper	0	0	0	0	0
25.	Other Prim. Metals	2,376	22,524	9,480	159,277	67,036
26.	Metal Fabricating	33,509	285,592	8,523	791,374	23,618
27.	Machinery	70,947	686,745	9,680	2,719,982	38,338
28.	Electric Machinery	24,303	266,956	10,984	951,801	39,164
29.	Motor Vehicles	6,428	61,049	9,497	492,622	76,635
30.	Aircraft,Parts	643	5,630	8,756	30,870	32,457
31.	Other Trans Equip.	4,801	40,143	8,361	221,922	46,224
32.	Instruments	16,925	187,270	11,065	399,343	23,595
33.	Misc. Manufacturing	12,622	66,838	5,295	178,496	14,142
34.	Trans. exc Pipeline	7,458	43,781	5,870	84,415	11,319
35.	Rail Transportation	15,927	186,212	11,692	519,541	32,620
36.	Local Transportation	8,052	66,663	8,279	122,503	15,214
37.	Trucking & Warehou.	24,608	247,713	10,066	441,456	17,940
38.	Air Transportation	7,188	72,002	10,017	348,287	48,454
39.	Communication	19,160	180,664	9,429	480,408	25,073
40.	Electrical Util.	5,865	64,874	11,061	380,401	64,860
41.	Gas Utilities	4,623	51,867	11,219	320,742	69,380
42.	Water Utilities	3,484	36,612	10,509	286,348	82,189
43.	Wholesale Trade	126,077	1,220,745	9,683	5,191,249	41,175
44.	Retail Trade	344,412	1,770,575	5,141	4,565,136	13,255
45.	Finance, Ins	73,082	633,851	8,673	1,453,594	19,900
46.	Real Estate	16,220	131,782	8,125	2,314,664	142,704
47.	Hotels, Per. Serv.	42,000	184,335	4,389	489,656	11,658
48.	Business Services	55,059	318,448	5,784	1,124,760	2-,428
49.	Auto Repair	16,048	54,144	3,374	433,818	27,033
50.	Amusements	19,342	80,491	4,161	155,457	8,037
51.	Medical,Educa	225,873	1,471,772	6,516	1,893,030	8,381
52	Federal Enterprise	16,777	155,340	9,259	230,784	13,756
53.	State & Local Ent.	27,950	255,132	9,128	674,042	24,116
54	Other Industry	19,963	66,216	3,317	271,852	13,618
	Total or Average	1,663,311	12,427,477	7,472	45,698,896	27,475

1/ Employment data from Minnesota Department of Employment Security and from Minnesota Department of Economic Development, earnings data from U.S Department of Commerce, Regional Economic Information System and other sources, gross output data from SIMAB.

Production of taconite pellets is both capital and energy intensive. Its expansion has shifted the total energy requirements of steel making towards the taconite production sites (2). This change in the geographical locus of energy utilization in steel making involved large capital expenditures in new production facilities in Northeast Minnesota and, also, a concommitant growth in a more technologically-oriented work force.

Industry Revitalization

The industry revitalization option implies large capital expenditures in new taconite production and steel making facilities and processes, but with a less-than-proportionate concentration of these expenditures in Northeast Minnesota. Much of the required capacity to handle the projected production expansion in Northeast Minnesota is in place already, unlike the Lower Lake states steel making facilities, which are in need of replacement and improvement. The earlier iron mining industry projection series, which are presented in Table 2.2, were based on a gradually increasing demand for Northeast Minnesota taconite pellets by the steel making industry in Illinois, Indiana, Michigan and Ohio.[3/]

The earlier projection series was based on a modest expansion in taconite production capacity of 20 percent, from about 65 million tons to nearly 78.6 million tons by the end of the 1990's. Industry-specific effects of the taconite industry expansion were simulated by the University of Minnesota Regional Development Simulation Laboratory (SIMLAB) for the earlier study, as summarized in Table 2.2. The simulated output, value added and employment effects were based on a projected year 2000 taconite production of

---

3/ Implementation of copper-nickel development plans for Northeast Minnesota are assumed, which accounts for the projected year 2000 gross output of $735,386,000 (in 1970 $) for nonferrous metals mining (4).

Table 2.2. Estimated and projected industry output (in 1977 dollars), value added (in 1970 dollars), and employment in specified industry, Minnesota, 1970 and 2000: Industry revitalization option.

Producing Sector No.	Title	Gross Output Estimated 1970 (thou.dol.)	Gross Output Projected 2000 (thou.dol.)	Value Added Estimated 1970 (thou.dol.)	Value Added Projected 2000 (thou.dol.)	Employment Estimated 1970 (no.)	Employment Projected 2000 (no.)
1.	Livestock, liv	2,109,900	3,896,462	618,663	1,142,517	68,748	43,090
2.	Other agricult	1,136,100	1,958,743	554,556	956,107	62,652	41,211
3.	Agricultura fo	50,459	64,370	32,864	41,924	3,298	4,878
4.	Iron and ferro	571,488	785,825	329,831	453,534	13,153	9,104
5.	Non ferrous me	7,932	735,386	4,846	440,279	146	2,692
6.	Copper ore min	0	0	0	0	0	0
7.	Stone and clay	67,264	126,140	40,331	75,533	2,197	1,274
8.	Construction	2,411,213	3,991,300	1,117,903	1,850,474	78,490	95,019
9.	Ordnance, acce	563,364	662,846	265,726	309,899	12,410	8,502
10.	Food, kindred	1,886,738	3,290,962	511,482	894,569	25,119	20,103
11.	Meat prod	1,730,800	3,314,524	307,743	589,336	17,350	18,629
12.	Grain mill pro	755,594	987,220	203,984	265,460	7,911	4,484
13.	Beverages, tob	308,100	650,159	182,089	384,248	4,702	3,849
14.	Apparel, and t	207,800	317,997	71,784	109,867	11,062	6,662
15.	Logging camps,	91,670	16,834	40,658	75,573	1,718	1,165
16.	Other lumber,	234,737	420,766	106,446	190,804	9,137	8,415
17.	Paper, allied p	1,408,535	2,641,451	591,606	1,109,449	31,468	25,437
18.	Printing, publ	648,200	1,479,764	301,869	689,130	24,173	33,474
19.	Chemicals, sel	466,090	852,362	162,551	303,783	6,599	3,580
20.	Petroleum indu	273,300	521,354	727,772	138,822	2,032	1,085
21.	Rubber, misc p	490,518	2,084,277	222,221	944,246	8,179	13,756
22.	Stone, clay gl	200,800	424,249	111,365	204,707	7,956	8,997
23.	Primary iron a	156,720	351,997	69,728	156,611	4,598	3,792
24.	Primary copper	0	0	0	0	0	0
25.	Other primary	131,180	364,334	49,463	137,376	2,558	2,742
26.	Fabricated met	694,190	1,005,111	298,454	432,128	20,427	30,992
27.	Machinery	2,202,879	6,713,162	937,118	2,855,820	65,990	104,812
28.	Elec. machiner	842,234	1,796,229	367,353	783,452	28,382	21,176
29.	Motor vehicles	476,200	748,730	139,587	245,220	4,814	4,219
30.	Aircraft and p	20,263	35,069	8,519	14,722	506	835
31.	Other transpor	201,428	446,085	79,336	175,690	5,333	5,774
32.	Instruments	373,400	1,145,258	186,210	571,126	13,039	18,230
33.	Miscellaneous	159,966	288,882	75,984	137,228	7,437	6,409
34.	Transportatio.	79,673	177,745	39,073	87,169	3,248	3,151
35.	Railroads and	445,152	800,744	297,787	535,662	20,225	7,997
36.	Local, suburba	107,635	142,592	74,433	98,600	7,268	8,312
37.	Motor freight	375,980	596,699	251,269	398,776	19,583	23,673
38.	Air transporta	227,505	1,450,999	132,960	848,041	7,627	10,594
39.	Communication	399,178	826,698	309,471	640,930	17,112	13,883
40.	Electric servi	335,550	606,878	134,112	242,556	5,403	3,897
41.	Gas service ex	282,425	503,084	184,937	329,440	4,267	3,531
42.	Water and sani	262,316	291,373	53,674	59,502	3,209	4,311
43.	Wholesale trad	3,667,317	11,237,826	2,479,546	7,598,119	93,466	155,336
44.	Retail trade e	3,520,113	8,764,252	2,676,490	6,663,829	269,931	428,790
45.	Finance and in	1,205,118	1,897,626	6,954,112	1,095,031	60,022	87,936
46.	Real estate an	1,975,649	3,772,537	1,430,891	2,732,313	10,056	14,757
47.	Hotels, motels	410,588	834,059	230,332	467,891	40,744	58,763
48.	Business and m	938,278	1,997,976	494,712	1,053,443	41,647	74,342
49.	Auto repair an	357,794	764,158	195,796	418,171	7,980	12,203
50.	Amusements	137,765	236,585	76,396	131,195	13,227	17,948
51.	Medical, educa	1,351,716	1,433,547	1,082,516	1,148,114	156,247	187,291
52.	Federal govern	189,085	411,036	133,812	290,883	17,268	25,757
53.	State and loca	625,777	900,738	325,491	468,509	26,892	34,363
54.	Other industry	223,674	513,509	79,340	182,148	21,282	32,211
	Totals 1/	37,975,480	80,439,099	19,452,666	42,179,081	1,398,287	1,763,445

1/ General government not included.

78,582,500 tons, which, at $10 per ton (in 1970 dollars), would have a producers' value of $785,825,000.

The projected changes in the Northeast Minnesota iron mining industry for the 1970-2000 period were associated with statewide changes in industry output, value added and employment as follows:

Indicator	Iron Mining	All Industry
Gross output (in mil. 1970 $)	214.3	43,463.3
Value added (in mil. 1970 $)	123.7	22,726.4
Employment (in thousands)	-4.4	365.1

The $214.3 million increase in primarily taconite output was associated with a $123.7 million increase in primarily taconite industry value added and a 4.4 thousand decrease in total iron mining employment. The decline in iron mining employment would be the result of output per worker increases exceeding the increase in gross output in the iron mining industry. During the same period, overall levels of industry output, value added and employment would increase in each case, as shown above.

Effects of further output expansion were simulated for the earlier study (7). Again, each of the three industry indicators are presented, but with reference to the previously projected baseline (i.e., the liquidation option of 45.52 million tons), as follows:

Indicator	Iron Mining	All Industry
Gross output (in mil. 1970 $)	330.6	1,090.3
Value added (in mil. 1970 $)	190.8	582.8
Employment (in thousands)	3.8	19.3

The second set of comparisons is for the same year, namely, the year 2000, rather than two different years. Differential rates of growth in output and employment thus are no longer a problem in deriving the long-run industry multipliers, which are as follows:

Indicator		
Gross output multiplier:	1,090.3/330.6	= 3.3
Value added multiplier:	582.8/190.8	= 3.1
Employment multiplier:	19.3/3.8	= 5.1

The long-run gross output and employment multipliers are larger than the long-run value added multiplier because of the high value added per $1 gross otuput and the high value added per worker in the iron mining industry.

For the additional industry output, the corresponding per worker indicators were projected as follows:

Indicator	Iron Mining	Other Industry
Gross output (in 1970 $)	86,317	56,596
Value added (in 1970 $)	49,817	30,254

Projected gross output per worker in the iron mining industry is 52.5 percent higher than in all other industry while projected value added per worker is 64.7 percent higher in the iron mining industry than all other industry. Projected value added per $1 gross output is 57.7 cents in the iron mining industry as compared with 53.5 cents in the all other industry group. Iron mining,and particularly, taconite production workers thus benefit from the high capital expenditures per employee and the high energy intensity of production processes.

Industry Liquidation

The industry liquidation strategy implies a sharp turn in iron mining development in Northeast Minnesota, as shown in Table 2.3. The projected level of 50 million tons in the liquidation option is more than 18 million tons below the industry revitalization projection (of 78.6 million tons). Actual production peaked in 1979 at 60 million tons -- a level 10 percent below total production capacity and 10 million tons above the projected peak production level in the liquidation option. The industry liquidation

Table 2.3. Projected effects of industry liquidation option on 1970 gross output (in 1970 dollars), value added (in 1970 dollars), and employment in specified industry, Minnesota, 1980 - 2000.

Industry No.	Industry Title	Gross Output Mining Baseline (thou. $)	Gross Output Liquidation Impact (thou. $)	Value Added Mining Baseline (thou. $)	Value Added Liquidation Impact (thou. D)	Employment Mining Baseline (no.)	Employment Liquidation Impact (no.)
1.	Livestock	3,875,354	-2,991	1,136,328	-854	42,856	-32
2.	Other Ag. Prod.	1,935,531	-3,201	944,777	-1,563	40,724	-67
3.	Ag. Serv.,For.,Fish.	64,370	0	453,534	0	4,878	0
4.	Iron Ores	455,200	-45,600	262,717	-26,318	5,274	-528
5.	Other Metal Ore	735,386	-15	440,279	0	2,692	0
6.	Copper Ore	0	0	0	0	0	0
7.	Non-Metal Mining	124,614	-211	74,431	-154	1,254	-3
8.	Construction	3,919,616	-9,887	1,817,238	-4,584	93,313	-235
9.	Ordnance	661,109	-240	308,087	-112	8,480	-3
10.	Food & Kindred,exc.	3,267,706	-4,449	885,825	-1,206	19,906	-27
11.	Meat Products	3,301,231	-1,833	586,973	-326	18,556	-10
12.	Grain Mill Prod.	944,226	-5,923	241,512	-3,303	4,289	-27
13.	Beverages	638,537	-1,603	377,380	-947	3,780	-10
14.	Apparel & Textiles	314,841	-435	108,777	-150	6,596	-9
15.	Logging	16,644	-26	74,679	-123	1,151	-2
16.	Wood Products	414,972	-799	188,175	-363	8,298	-16
17.	Paper Products	2,628,621	-1,770	1,104,060	-743	25,313	-17
18.	Printing, Publ.	1,472,384	-1,018	685,693	-474	33,307	-23
19.	Chemicals	841,732	-1,466	299,995	-552	3,535	-6
20.	Petroleum & Related	511,813	-1,316	136,282	-350	1,065	-3
21.	Rubber & Plastic	2,077,768	-898	941,297	-407	13,714	-6
22.	Stone, Clay,Glass	417,841	-884	201,614	-426	8,862	-19
23.	Primary Iron	344,727	-1,003	153,376	-446	3,714	-11
24.	Primary Copper	0	0	0	0	0	0
25.	Other Prim. Metals	361,451	-398	136,287	-150	2,721	-3
26.	Metal Fabricating	1,002,286	-390	430,913	-168	30,905	-12
27.	Machinery	6,660,926	-7,204	2,833,599	-3,065	103,994	-113
28.	Electric Machinery	1,770,081	-3,606	772,047	-1,573	20,868	-42
29.	Motor Vehicles	735,860	-1,775	241,045	-576	4,147	-10
30.	Aircraft,Parts	34,788	-39	14,604	-16	829	-1
31.	Other Trans. Equip.	439,475	-912	173,086	-359	5,688	-12
32.	Instruments	1,140,348	-677	568,677	-338	18,152	-11
33.	Misc. Manufacturing	285,257	-501	135,502	-238	6,328	-11
34.	Trans. exc. Pipeline	168,243	-1,310	82,508	-642	2,981	-23
35.	Rail Transportation	792,455	-1,143	530,115	-765	7,914	-11
36.	Local Transportation	142,463	-16	98,517	-11	8,305	-1
37.	Trucking & Warehou.	596,357	-47	398,403	-51	23,659	-2
38.	Air Transportation	1,444,213	-936	884,075	-546	10,544	-7
39.	Communication	816,518	-1,404	633,036	-1,089	13,712	-24
40.	Electrical Util.	578,623	-3,897	231,263	-1,557	3,716	-25
41.	Gas Utilities	487,275	-2,180	319,087	-1,428	3,421	-15
42.	Water Utilities	291,373	0	59,502	0	4,311	0
43.	Wholesale Trade	11,184,049	-7,417	7,561,759	-5,-15	154,592	-103
44.	Retail Trade	8,655,152	-15,047	6,580,877	-11,441	423,452	-736
45.	Finance, Ins	1,897,554	-10	1,094,999	-6	87,932	-1
46.	Real Estate	3,724,197	-6,667	2,697,336	-4,824	14,567	-26
47.	Hotels, Per. Serv.	822,476	-1,598	461,393	-896	57,947	-113
48.	Business Services	1,975,496	-3,100	1,041,591	-1,635	73,505	-115
49.	Auto Repair	754,077	-1,390	412,654	-761	12,042	-22
50.	Amusements	233,453	-432	129,458	-240	17,711	-33
51.	Medical,Educa.	0	0	1,148,114	0	187,291	0
52.	Federal Enterprise	405,380	-780	286,880	-552	25,302	-48
53.	State & Local Ent.	893,076	-1,057	464,524	-550	34,070	-40
54.	Other Industry	508,580	-680	180,400	-241	31,901	-43
	Total 1/	79,348,807	-150,374	41,596,253	-80,384	1,744,180	-2,657

1/ General government not included.

strategy thus results in an 18.6 million ton shortfall relative to the industry revitalization option.

While the industry liquidation focuses on the taconite mining industry, the projected employment and income effects of this option are dispersed throughout the Minnesota economy because of interindustry linkages (specifically, with input suppliers, who, in turn, are linked to their input supplier and so on). Because of the multiplier effects resulting from these linkages, an initial production cutback results in additional input supply cutbacks. For example, the projected iron mining industry output of $455,200,000 in Table 2.3 is $45,600,000 below the 1980 industry output. Associated with the projected year 2000 industry output is an industry value added of $262,717,000 and an industry employment of 5,274.

According to the computer simulation runs cited earlier, the year 2000 Minnesota economy (excluding general government) would differ in the industry revitalization and industry liquidation options,as follows:

Indicator	Industry Revitalization	Industry Liquidation	Difference
Gross output (in mil. 1970 $)	80,439.1	79,348.8	-1,090.3
Value added (in mil. 1970 $)	42,179.1	41,596.3	-582.8
Employment (in thousands)	1,763.4	1,744.2	-19.2

The projected differences of more than $1 billion in gross output, of nearly $0.6 billion in value added, and of more tha 19 thousand in employment are associated with corresponding projected differences in the iron mining industry, as follows:

Indicator	Industry Revitalization	Industry Liquidation	Difference
Gross output (in mil. 1970 $)	785.8	455.2	-330.6
Value added (in mil. 1970 $)	453.5	262.7	-190.8
Employment (in thousands)	9.1	5.2	-3.9

Thus, a projected difference of -$330,600,000 in iron mining industry output is associated with a projected difference of -$1,090,300,000 in all industry (excluding general government output) for the two industry options. Similarly, projected differences of -$190,800,000 in value added and -3,900 in employment are associated with projected differences of -$582,800,000 and -19,200, respectively, in all industry value added and employment.

Finally, the liquidation option represents a reduction in total economic activity below levels that would occur were mining industry gross output to remain at its 1980 level of 50.08 million tons, as show below:

Indicator	Fixed Min. Ind. Output	Industry Liquidation	Difference
Gross output (in mil. 1970 $)	79,499.2	79,348.8	-150.4
Value added (in mil. 1970 $)	41,676.6	41,596.2	-80.4
Employment (in thousands)	1,746.9	1,744.2	-2.7

Associated with the all industry activity levels are corresponding mining industry activity levels, and their differences, as follows:

Indicator	Fixed Min. Ind. Out.	Industry Liquidation	Difference
Gross output (in mil. 1970 $)	500.8	455.2	-45.6
Value added (in mil. 1970 $)	289.0	262.7	-26.3
Employment (in thousands)	5.8	5.3	-0.5

Thus, the projected differences between the fixed (1980) mining industry output level and the liquidation option, which are based on the same computer simulation runs cited in the preceding discussion on the industry revitalization option, are roughly one-third of the differences between the

industry revitalization and the industry liquidation options. In effect, the turnabout in projected trends from the industry revitalization option to the industry liquidation option is more critical in its reversal of anticipated growth trends than its projected decline from current production levels.

DRI Development

Statewide industry effects of DRI development are small compared with the industry effects of two preceding options. The projected taconite industry expansion effects associated with the DRI development are in aggregate and in absolute numbers only one-third as large as the liquidation effects relative to 1980 iron mining industry production. If the DRI development itself were to have equally large industry effects as the mining industry, the combined all industry output expansion would still fall below the level projected for the industry revitalization option. The DRI development option is a "fall-back" position in case the industry revitalization option is not available and the industry liquidation option is unacceptable without efforts to fund and develop alternative markets for Northeast Minnesota taconite production.

The industry effects of the DRI development option are compared with the corresponding industry effects of the industry revitalization option in Table 2.4. In other words, to the projected year 2000 mining baseline activity levels associated with the industry liquidation option (in Table 2.3) can be added the industry-specific effects of mining industry output expansion due to these two options (in Table 2.4) to obtain the two additional mining industry projection series associated with each of the two aditional options.

Effects of year 2000 industry activity levels associated with the two industry options are as follows:

Tab.e 2.4. Projected effects of DRI development and industry revitalization options on gross output (in 1970 dollars), value added (in 1970 dollars) and employment in specified industry, Minnesota, 2000.

Industry No	Industry Title	Gross Output: DRI Development (thou. $)	Gross Output: Industry Revitalization (thou. $)	Value Added: DRI Development (thou. $)	Value Added: Industry Revitalization (thou. $)	Employment: DRI Development (no.)	Employment: Industry Revitalization (no.)
1.	Livestock	6,181	21,108	1,812	6,189	69	234
2.	Other Ag. Prod	6,795	23,212	3,317	11,330	143	487
3.	Ag. Serv.,For.,Fish.	0	0	0	0	0	0
4.	Iron Ores	96,800	330,625	55,868	190,817	1,121	3,830
5.	Other Metal Ore	32	109	0	0	0	0
6.	Copper Ore	0	0	0	0	0	0
7.	Non-Metal Mining	447	1,526	326	1,102	6	20
8.	Construction	20,988	71,648	9,731	33,236	500	1,706
9.	Ordnance	509	1,737	238	812	7	22
10.	Food & Kindred,exc.	9,444	32,256	2,561	8,744	58	197
11.	Meat Products	4,892	13,293	692	2,363	22	74
12.	Grain Mill Prod.	12,573	42,944	7,011	23,948	57	195
13.	Beverages	3,403	11,622	2,011	6,868	20	69
14.	Apparel & Textiles	924	3,156	319	1,090	14	66
15.	Logging	56	190	262	894	4	14
16.	Wood Products	1,697	5,794	770	2,629	34	117
17.	Paper Products	3,756	12,830	1,578	5,389	36	124
18.	Printing, Publ	2,161	7,380	1,006	3,437	49	167
19.	Chemicals	3,112	10,630	1,109	3,788	24	45
20.	Petroleum & Related	2,793	9,541	744	2,540	6	20
21.	Rubber & Plastic	1,096	6,509	863	2,949	12	42
22.	Stone, Clay,Glass	1,876	6,408	905	3,093	40	135
23.	Primary Iron	2,129	7,270	947	3,235	23	78
24.	Primary Copper	0	0	0	0	0	0
25.	Other Prim. Metals	845	2,885	319	1,089	6	21
26.	Metal Fabricating	827	2,825	356	1,215	25	87
27.	Machinery	15,244	52,236	6,506	22,221	240	818
28.	Electric Machinery	7,656	26,148	3,339	11,405	90	308
29.	Motor Vehicles	3,768	12,870	1,222	4,175	21	72
30.	Aircraft,Parts	83	281	34	118	2	6
31.	Other Trans. Equip.	1,935	6,610	762	2,604	25	86
32.	Instruments	1,438	4,910	717	2,449	23	78
33.	Misc. Manufacturing	1,064	3,625	505	1,726	24	81
34.	Trans. exc. Pipeline	2,782	9,502	1,365	4,661	50	170
35.	Rail Transportation	2,427	8,289	1,624	5,547	23	83
36.	Local Transportation	35	119	24	83	2	7
37.	Trucking & Warehou.	100	342	109	373	4	14
38.	Air Transportation	1,261	6,786	1,161	3,966	15	50
39.	Communication	2,981	10,180	2,311	7,894	50	171
40.	Electrical Util.	8,273	28,255	3,306	11,293	53	181
41.	Gas Utilities	4,628	15,809	3,031	10,353	32	110
42.	Water Utilities	0	0	0	0	0	0
43.	Wholesale Trade	15,745	53,777	10,646	36,360	218	744
44.	Retail Trade	31,909	109,100	24,287	92,952	1,563	5,338
45.	Finance, Ins.	21	72	12	41	1	4
46.	Real Estate	14,153	48,340	10,241	34,977	56	190
47.	Hotels, Per. Serv.	3,391	11,583	1,902	6,489	239	816
48.	Business Services	6,582	22,480	3,470	11,852	245	837
49.	Auto Repair	2,952	10,081	1,615	5,518	47	161
50.	Amusements	917	3,132	509	1,737	69	237
51.	Medical,Educa.	0	0	0	0	0	0
52.	Federal Enterprise	1,656	5,656	1,172	4,003	102	350
53.	State & Local Ent.	2,243	7,662	1,167	3,985	86	293
54.	Other Industry	1,443	4,928	512	1,748	91	310
	Totals 1/	319,214	1,090,292	170,640	582,828	5,640	19,265

1/ General government not included.

Indicator	DRI Development	Industry Revitalization
Gross output (in mil. 1970 $)	319.2	1,090.9
Value added (in mil. 1970 $)	170.6	582.8
Employment (in thousands)	5.6	19.3

Corresponding iron mining industry activity levels would expand under the two industry options as follows:

Indicator	DRI Development	Industry Revitalization
Gross Output (in mil. $)	96.8	330.6
Value added (in mil. $)	55.9	190.8
Employment (in thousands)	1.1	3.8

Thus, associated with an iron mining industry projected expansion of $96.8 million in gross output under the DRI development option is a corresponding all industry gross output increase of $319.2 million -- all in 1970 dollars and with respect to projected year 2000 industry activity levels under the industry liquidation option. These comparisons thus confirm the finding that the taconite production levels and the related industry effects are about 50 percent larger under the industry revitalization option than DRI effects, given an economic impact from the DRI development itself equally large as the impact from the expansion in taconite production and related employment and income payments.

STATEWIDE FISCAL EFFECTS

Statewide fiscal effects of DRI development in Northeast Minnesota are studied also in the context of the findings of an earlier report on the fiscal effects of iron mining industry expansion in Minnesota (6). Individual tables in the earlier report are updated for use in this report and the findings are re-examined with respect to the fiscal inpact of the two additional industry options presented here. Exactly the same data organization is followed here as in the earlier report, except for the exclusion of other mineral-related industry.

Taxes Originating in Mineral-Related Industry

Minnesota state and local tax revenues originating in the mineral-related industries include the principal public income sources -- income taxes and sales and use taxes. They include, also, special taxes, like the gross earnings tax on the railroads owned by taconite producers, the royalty tax, the occupation tax, and the production tax. The occupation tax, which applies to the iron mining, taconite and copper-nickel industries, substitute for the corporate income tax, while the production tax is in lieu of local property taxes.

Tax revenues derived from all economic units in the state, as shown in Table 3.1, accounted for $1.9 billion, or 64.5 percent, of the $3 billion total general revenues in 1970. By 1975, tax revenues were nearly $3.3 billion, or 60.4 percent of the $5.4 billion total general revenues. Thus, while tax revenues increased an average 13.8 percent per year in the five-year period from 1970, they declined as a proportion of total governmental revenues. Federal government transfers to state and local agencies in Minnesota increased from 35.5 percent to 39.6 percent of total revenues over the five-year period. In the next three years, however, intergovernmental

Table 3.1. General Revenue of State and Local Government From Specified Source, Minnesota, 1970-71, 1975-76 and 1978-79.

Source	1970-71 Total[1/] (thou.$)	1970-71 Proportion of Total (pct.)	1975-76 Total[2/] (thou.$)	1975-76 Proportion of Total (pct.)	1978-79 Total[3/] (thou.$)	1978-79 Proportion of Total (pct.)	Average Annual Change 1970-71 to 1975-76 (pct.)	Average Annual Change 1975-76 to 1978-79 (pct.)
General Revenue, Total	2,993.4	100.0	5,400.9	200.0	7,431.3	100.0	16.1	12.5
Intergovernmental:								
From Fed. Govt.	485.6	16.2	1,114.9	20.6	1,427.0	19.2	25.9	9.3
From State Govt.	4/	--	4/	--	4/	--	--	--
Own Sources, Total	2,507.8	83.8	4,286.0	79.4	6,004.3	80.8	14.2	13.4
Property Taxes	817.6	27.3	1,007.9	18.7	1,260.0	17.0	4.7	8.3
General Sales Taxes	186.9	6.2	429.1	7.9	608.0	8.2	25.9	13.9
Income Taxes, Total	445.9	14.9	1,046.0	19.4	1,613.0	21.7	26.9	18.1
Severance & Tonnage Taxes:								
Iron Ore Royalty Tax	0.9	5/	0.7	5/	0.9	5/	-4.4	6.9
Taconite Roytaly Tax	0.8	5/	2.8	0.1	4.1	0.1	50.0	15.4
Copper-Nickel Royalty Tax	5/	5/	5/	5/	5/	5/	--	5/
Iron Ore Occupation Tax	9.3	0.3	5.1	0.1	4.5	0.1	-9.0	-3.8
Taconite Occupation Tax	3.2	0.1	19.2	0.4	25.6	0.3	100.0	11.1
Taconite Production Tax	4.3	0.1	30.3	0.6	69.2	0.9	120.9	42.7
Total	18.4	0.5	58.2	1.1	104.3	1.4	43.3	26.4
Other Taxes	462.8	15.5	778.9	14.4	970.0	13.1	16.0	8.2
Charges & Misc.	576.2	19.2	1,024.1	19.0	1,449.0	19.5	15.5	13.8

1/ U.S. Bureau of the Census, Governmental Finances in 1970-71, U.S. Government Printing Office, Washington, D.C., 1972.

2/ U.S. Bureau of the Census, Governmental Finances in 1975-76, U.S. Government Printing Office, Washington, D.C., 1977.

3/ U.S. Bureau of the Census, Governmental Finances in 1978-79, U.S. Government Printing Office, Washington, D.C., 1980.

4/ Duplicative transactions between levels of government are excluded.

5/ $0.5 million or 0.05 percent or less.

transfers expanded less rapidly than own revenue sources, including both taxes and service charges. Among tax revenues, the largest increases were due to the severance taxes levied on businesses in the iron mining industry.

Wide differences have occurred in the average annual growth rates for individual tax sources. While property taxes increased at a 4.7 percent rate, general sales, income, and severance and tonnage taxes increased ab above-average rates -- 25.9 percent, 26.9 percent and 43.3 percent, respectively, during the 1970 to 1975 period. Similar diversity in average annual growth rates for the 1975-1978 period is indicated in the summary data in Table 3.1. For the iron mining industry, the diversity in tax growth rates can be attributed largely to the shift from natural iron ores to taconite production and from the occupation tax to the production tax.

Mineral Taxes

The three mineral taxes -- the occupation tax, the production tax and the royalty tax -- have generally increased in yield in the 1970's, except for the shift from natural ores to taconite, as shown in Table 3.2. Much of the yield increase is the result of the recent escalation in the taconite production tax rate, which is adjusted to the inflation rate for the taconite price index.

The specified tax rates are multiplied by the value of production and/or the quantity of production to obtain the tax yields listed in Table 3.3. These data show the recent shift to the taconite production tax as the principal source of mineral tax revenues in the state. In 1980, the taconite production tax (based on 1979 production year for payment in fiscal year 1979) contributed over $88 million, or 79.1 percent, of the $111.8 million in total state revenues from mineral taxes.

Table 3.2

Mineral Tax Rates in Minnesota, 1970-1980.[1/]

Production Year	Occupation Tax			Production Tax		Royalty Tax		
	Iron Ore [2/]	Taconite [3/]	Copper-Nickel [4/]	Taconite [5/]	Copper-Nickel [6/]	Iron Ore [7/]	Taconite [8/]	Copper-Nickel [9/]
	(percent)	(percent)	(percent)	(cents)	(cents)	(percent)	(percent)	(percent)
1970	12.0	12.0	1.0	11.5	2 5	12.0	12.0	12.0
1971	15.5	15.0	1.0	15.5	2 5	15 5	15.0	15.0
1972	15.5	15.0	1.0	18.5	2.5	15.5	15.0	15.0
1973	15.5	15.0	1.0	20.5	2.5	15.5	15.0	15.0
1974	15.5	15.0	1.0	29 7	2.5	15.5	15.0	15.0
1975	15.5	15.0	1.0	74.9	2.5	15.5	15.0	15.0
1976	15.5	15.0	1.0	76.5	2.5	15.5	15.0	15.0
1977	15.5	15.0	1.0	129.5	2.5	15.5	15.0	15.0
1978 [10/]	15.5	15.0	1.0	139.9	2.5	15.5	15.0	15.0
1979 [10/]	15 5	15.0	1.0	159.8	2.5	15.5	15.0	15.0
1980 [10/]	15.5	15.0	1.0	174.0 [11/]	2.5	15.5	15.0	15.0

1/ Minnesota Department of Revenue. Minnesota Mining Tax Guide. Minnesota Department of Revenue, Centennial Office Building, St. Paul, Minnesota, 55101, July 1978.

2/ Since 1941 certain deductions and credits, including a labor credit, have been allowed to encourage the utilization of low-grade, underground, high labor cost ores.

3/ A separate occupation tax on the mining and production of taconite, semi-taconite and iron sulphides was passed in 1971.

4/ Production cost allowances and credits for research and for experimentation and exploration are deducted from the 1 percent rate.

5/ As escalator based on iron content and an additional escalator based on the wholesale price index were in effect until 1971 when an additional tax was passed and 1975 when a second additional tax was passed. The last major change in the taconite production tax occurred in 1977 when the additional taxes were repealed and the basic tax rate was increased to $1.25 per ton of merchantable iron ore produced in 1977. For 1978, the basic rate of $1.25 was increased by the rate of growth in the steel mill production index for January of the production year.

6/ Base production tax for copper-nickel ore is 2.5¢ per gross ton plus 10% of the base tax for each 1% that the average copper-nickel content per gross tax exceeds 1%. This total is then subject to an increase proportional to any increase in the current year average monthly wholesale price index for all commodities over the 1967 monthly average.

7/ Gross tax rate on royalties follows the occupation tax rate, with all taxes being collected from the leasee.

8/ A credit which reduces the effective royalty tax rate to the effective rate for occupation taxes is allowed for taconite, semi-taconite and iron sulphide royalty taxes on land that is being mined.

9/ An additional 1% royalty tax is collected on royalties paid on leases for silver, gold, platimun, and other precious metals.

10/ Minnesota Department of Revenue. Minnesota Tax Handbook. Minnesota Department of Revenue, Research Office, Centennial Office Building, St. Paul, Minnesota, 55101. January 1981.

11/ Marvin Guesford. Personal communication. Minnesota Department of Finance, Minerals Division, State Administration Building, St Paul, Minnesota, 55101 June 1981.

Table 3.3. Estimated State Tax Revenue from Iron Ore, Taconite and Copper-Nickel Production in Minnesota, 1970-1979. 1/

Production Year	Occupation Tax		Taconite Production Tax	Royalty Tax			Total
	Natural Ores	Taconite		Iron Ore	Taconite	Copper-Nickel	
	(thousand dollars)						
1970	9,278	3,177	4,253	966	787	3	18,464
1971	7,310	5,388	4,400	705	1,323	3	19,129
1972	6,376	3,664	5,539	904	1,402	2	17,887
1973	8,836	6,885	10,164	1,289	1,886	2	29,032
1974	9,698	10,235	11,952	1,351	1,994	2	35,234
1975 3/	5,103	19,218	30,347	731	2,770	2	58,171
1976 3/	6,916	18,141	30,868	752	3,039	2	59,718
1977 3/	3,946	6,247	48,810	945	1,905	3	61,856
1978 3/	4,522	25,604	69,222	882	4,046	21	104,297
1979 3/	2,702	14,539	88,484	924	5,125	35	111,809

1/ Minnesota Department of Revenue, Minnesota Mining Tax Guide. Minnesota Department of Revenue, Centennial Office Building, St. Paul, Minnesota, 55101. July 1978.

2/ Minnesota Department of Economic Development and Minnesota Department of Revenue, Minnesota Tax Guide, 1978, Minnesota Department of Revenue, Centennial Office Building, St. Paul. 1979.

3/ Minnesota Department of Revenue, Minnesota Tax Handbook, Minnesota Department of Revenue, Research Office, Centennial Office Building, St. Paul. 1981.

Distribution of state mineral tax revenues follows a prescribed set of rules, as shown in Table 3.4. While the distribution formula has been fixed for the occupation tax, it has changed repeatedly for the production tax in recent years. Major beneficiaries of these changes are the Economic Protection Fund and the Environmental Protection Fund. Both funds are administered by the Iron Range Resource and Rehabilitation Board.

Actual disbursements of state mineral tax revenues to state and local agencies are listed in Table 3.5. Large increases are shown in the revenue disbursements to local agencies, including counties, municipalities, and school districts. Total local disbursements increased from $9,716,000, or 52.6 percent of total disbursements in fiscal year 1970, to $97,057,000 or 86.8 percent of the total in fiscal year 1979.

Projected Mineral Tax Revenues

Projected mineral tax revenues for the 1980-1989 period, even under the industry liqiudiation option, are more than twice the mineral tax revenues for the 1970-79 period (Table 3.6). The only variables introduced into the projections are the price index for determining the price of iron ore at the mine and the production tax rate, and total production.[5/] Of the two variables, the price effect is much larger than the production (expansion) effect, as demonstrated by the more than two-fold increase in 10-year accumulated revenues even when total production declines.

Total taconite tax revenues are projected to range from nearly $1.4 billion to nearly $1.9 billion (in current dollars) for the 10-year period

---

5/ The price of iron ore at the mine and the taconite production tax rate were assumed to increase at 5 percent annual rates, starting at $34.00 and 174 cents per ton, respectively, in 1980. All production is treated as if it were taconite.

Table 3.4

Distribution of Mineral Tax Revenues to State and Local Governments in Minnesota, 1970-1980. [1/]

Production Year	Occupation Tax					Production Tax										
	School Districts	University	Iron Range Rehab. Res. Board	State	Total	Cities and Towns	Taconite Municipal Aid	School Districts	Counties	Property Tax Relief	Iron Range Rehab. Res. Board	Economic Protection Fund	Environmental Protection Fund	Minnesota Dept. of Revenue	State	Total
	(pct.)	(pct.)	(pct.)	(pct.)	(pct.)	(cents)	(cents)	(cents)	(cents)	(cents)	(cents)	(cents)	(cents)	(cents)	(cents)	(cents)
1970	40	10	5	45	100	1 4	0	3.2	1.4	5.6	0	0	0	0	0.4	12.0
1971	40	10	5	45	100	1.0	2.0	2.5	1.5	5 2	0.5	0	0	0	0.3	12.0
1972	40	10	5	45	100	1.0	3.0	2.5	2.0	6.2	1.0	0	0	0	0.3	16.0
1973	40	10	5	45	100	1.7	4.1	4.2	2.9	9.8	1.2	0	0	0	0.4	24.3
1974	40	10	5	45	100	2.0	5.7	4.8	3.4	11.3	1.4	0	0	0	0.5	29.1
1975	40	10	5	45	100	2 3	8,3	25.6	10.7	21.3	2.6	0	0	0	0.6	74.4 [2/] [2/]
1976	40	10	5	45	100	2.3 [3/]	8.8	25.7 [3/]	10.8 [3/]	22.7	2 2 [4/]	0	0	0	0.6	76.0 [7/]
1977	40	10	5 [8/]	45 [8/]	100	2.5 [3/]	12.5	29.0 [3/]	19.5 [3/]	25.75	3 0 [4/]	9 2 [5/]	18,4 [5/]	0.4 [6/]	1.0	129.4 [7/]
1978	40	10	(5) [8/]	(45) [8/]	100	2.5 [3/]	12.5	29.0 [3/]	19.5 [3/]	25.75	3.0 [4/]	11.0 [5/]	22.0 [5/]	0.3 [6/]	1.0	139.9 [7/]
1979	40	10	(5) [8/]	(45) [8/]	100	2.5 [3/]	12.5 [9/]	29.0 [3/]	19.5 [3/]	25.75	3.0 [4/]	13,8 [5/]	27,6 [5/]	0.2 [6/]	1.0	159.8 [7/]
1980	40	10	(5) [8/]	(45) [8/]	100	2.5 [3/]	12.5 [9/]	29.0 [3/]	19.5 [3/]	25 75	3.0 [4/]	23,4 [5/]	23,4 [5/]	0,2 [6/]	1.0	174 0 [7/]

1/ Minnesota Department of Revenue. Minnesota Mining Tax Guide. Minnesota Department of Revenue, Centennial Office Building, St. Paul, Minnesota 55101, July 1978. Royalty tax revenue is deposited in the general fund and not earmarked for any specific distribution.

2/ Based on an allocation of $1,250,000 to filtration fund.

3/ Fixed distribution of $3,160,899 to counties, cities, towns and school districts is included only in total.

4/ Fixed distribution of $1,252,520 to Iron Range Resources and Rehabilitation Board is included only in total.

5/ Remainder is distributed one-third to Northeast Minnesota Economic Protection Fund and two-thirds to Taconite Environmental Protection Fund.

6/ In 1978 (1977 production year) and each year thereafter Department of Revenue shall receive $50,000 for auditing and enforcing the taconite and production tax. In 1978 and 1979 it shall receive an additional $150,000 for administering section 298.48 mineral rights, exploration data, filing requirements and penalties; and in 1980 (1979 production year) and each year thereafter, $100,000 shall be distributed to the Department of Revenue. In 1980 this law was changed to 1 cent per ton charge for administration.

7/ Production tax revenues are not adjusted to taxes due or paid for prior years.

8/ Constant dollar amount (5 percent of total 1977 proceeds) is earmarked for the Iron Range Resources and Rehabilitation Board.

9/ Includes payment of 0.2 cents per ton to Range Association of Municipalities and Schools.

Table 3.5

Estimated Total Mineral Tax Revenues of State and Local Governments in Minnesota, 1970-1980 [1/]

Production Year	Cities and Towns	Municipal Aid Account	School Districts	Counties	Property Tax Relief	Iron Range Res. and Rehabil. Board	Economic Protection Fund	Environmental Protection Fund	University	Minnesota Department of Revenue	State	Total Revenues
					(thousand dollars)							
1970	496	0	6,116	496	1,985	623	0	0	1,246	0	7,503	18,465
1971	338	677	5,925	508	1,760	804	0	0	1,270	0	7,847	19,129
1972	346	1,039	4,881	692	2,147	848	0	0	1,004	0	6,930	17,887
1973	711	1,715	8,036	1,213	4,099	1,287	0	0	1,569	0	10,405	29,032
1974	807	2,323	9,928	1,400	4,675	1,576	0	0	1,992	0	12,529	35,230
1975	2,187 [2/]	3,400	20,146	4,363	8,688	2,286	0	0	2,426	0	14,676	58,171
1976	2,194 [2/]	3,571	20,314	4,374	8,957	2.338	0	0	2,475	0	15,495	59,718
1977	943	4,715	15,016 [3/]	7,355 [3/]	9,713	2,385	4,479	8,957	1,019	200	7,074	61,856
1978 [4/]	1,241	6,206	26,447 [3/]	9,681 [3/]	12,783	2,742	9,345	18,691	3,013	200	13,948	104,297
1979 [4/]	1,384	6,921	22,954	10,797	14,258	3,892	12,250	24,501	1,724	100	13,028	111,809
Total	10,647	30,567	139,760	39,777	69,065	18,781	26,074	52,149	17,738	500	109,010	515,504

1/ Minnesota Department of Revenue. Minnesota Mining Tax Guide. Minnesota Department of Revenue, Centennial Office Building, St. Paul, Minnesota, 55101, July 1978.

2/ Includes $1,250,000 for filtration fund.

3/ Fixed distribution of $3,160,899 to counties, cities, towns and school districts included only in total production tax receipts.

4/ Minnesota Department of Revenue, Minnesota Tax Handbook. Minnesota Department of Revenue, Research Office, Centennial Office Building, St. Paul, Minnesota, 55101. January 1981.

Table 3.6

Projected Iron Ore and Taconite Mining Tax Revenues With Specified Industry Option, Minnesota, 1980-89.

Type of Government	Industry Liquidation	DRI Development	Industry Revitalization	Expansion Effect: DRI Development	Expansion Effect: Industry Revitalization
	(thousand dollars)				
Local Government:					
Cities and Towns	12,538	12,692	16,822	154	4,284
Municipal Aid	62,688	63,462	84,112	774	21,424
School Districts	236,596	230,637	318,406	3,041	81,810
Counties	97,792	99,002	131,216	1,210	33,424
Property Tax Relief	129,136	130,733	173,272	1,597	44,136
Iron Range Res. & Reh.	27,415	27,601	32,557	186	5,142
Econ. Prot. Fund	209,463	212,832	289,057	3,369	79,594
Environ. Prot. Fund	418,926	425,664	578,114	6,738	159,188
Total	1,194,554	1,211,623	1,623,556	17,069	429,002
State Government	175,977	178,521	241,890	2,544	65,913
All Governments	1,370,531	1,390,144	1,865,446	19,613	494,915

from 1980 to 1989. On a per worker basis, taconite-related tax revenues are projected to increase from $7,491 in 1979 to more than $12,000 in the 1985-89 period -- a trend starting in the 1970's when mineral-related tax revenues increased rapidly, as shown below:

Industry	1970 (dol.)	1978 (dol.)	Average Annual Increase (pct.)
Iron Mining	1,399	7,491	54.4
All Industry	1,793	3,610	12.6

In 1970, mineral tax revenues collected from the iron mining industry totaled to $1,399 per iron mining employee. This compares with an overall industry figure for the state of $1,793 per worker. By the 1978 fiscal year, however, the mineral-related taxes were more than five times their 1970 level, while the corresponding figure for all state and local taxes was only twice as large. Comparable projected yearly tax revenues per worker in the iron mining industry under the three industry options are as follows:

Industry Option	1980-84 (dol.)	1985-89 (dol.)	Average Annual Change 1978-80/84 (pct.)	Average Annual Change 1982-85/89 (pct.)
Industry Liquidation	9,438	12,490	5.8	6.5
DRI Development	9,438	12,642	5.8	6.8
Industry Revitalization	11,504	17,421	11.9	10.3

The annual increases in mineral-related taxes are smaller for the 1980's than the 1970's because of the assumption of constant tax structure. Price inflation is the principal source of tax revenue expansion in these projections.

The distribution of the mineral-related tax revenues to units of government and to the state treasurery is indicated in Tables 3.5 and 3.6. The percentage distributions show the increasing importance of tax revenue

allocations to the economic and environmental protection funds administered by the Iron Range Resource and Rehabilitation Board, as follows:

Type of Government	Esti-mated 1977-79	Projected 1980-89 Industry Liquida-tion	DRI Develop-ment	Industry Revitali-zation
		(percent)		
Municipalities & Counties	17.7	12.6	12.6	12.4
School Districts	23.2	17.3	17.2	17.1
Property Tax Relief	13.2	9.4	9.4	9.3
Econ. & Environmental	31.4	47.9	47.9	48.2
State Government	14.5	12.8	12.8	13.0
Total	100.0	100.0	100.0	100.0

While the relative importance of revenue allocations to municipalities and counties, school districts and the two protection funds is declining, the total value of these allocations is increasing. The absolute changes are positive because of the very large price effect cited earlier.

The small differences in revenue allocations among types of government are due to the counter-balancing effects of production and price changes in mineral-related tax collections. Local school districts in the taconite mining and processing areas are recipients of pre-assigned shares of both the occupation tax and the production tax (see, Table 3.4). The occupation tax is based wholly on the value of production while the production tax is on a tonnage basis but the tax rate per ton is linked to the Lower Lakes ports price index for taconite pellets.

The distribution of tax revenues, by type of tax, is shifting towards the production tax, as shown below:

Type of Tax	Estimated 1975-79	Projected (Liquid. Opt.) 1980-84	1985-89
		(million dollars)	
Production	267.8	485.8	616.2
Occupation	106.9	108.7	119.2
Royalty	21.2	21.7	23.8
Total	395.9	616.2	754.2

Thus, the production tax is projected to increase from 67.6 percent of total severance tax revenues in the 1975-79 period to 78.8 percent of the total in the 1980-84 period and 81.7 percent of the total in the 1985-89 period.

The production tax, which is levied in lieu of a property tax for mineral-related industry, is also increasing more rapidly than both property taxes and corporate net income taxes. Indeed, total mineral-related tax revenues are increasing more rapidly than the combined property taxes and corporate net income taxes, as shown below:

State & Local Revenue Source	1970-71	1975-76	1976-77	1977-78	1978-79	1979-80
Iron Mining-Related Taxes (mil. $)	18.4	58.2	59.7	61.9	104.3	111.8
Property & Corp. Net Inc. Taxes (mil. $)						
Property Tax	897.6	1,202	1,333	1,495	1,617	1,820
Corp. Net Inc. Tax	817.6	1,006	1,075	1,202	17,260	1,439
Iron Mining as Prop. of Prop. & Corp. Net Inc. Taxes (%)	2.1	4.8	4.5	4.1	6.5	6.1

Mineral-related taxes levied on iron mining businesses in Minnesota are equivalent to six percent or more of total property and corporate net income taxes collected by local and state governments. Yet, total employment in the iron mining industry is less than one percent of all industry employment in the state. Local governments in the taconite mining area identified in Figure 1.1 thus are becoming increasingly dependent on mineral-related taxes as sources of revenue for supporting essential municipal and educational services.

REFERENCES CITED

1. Lyche, Harald C. and Wilbur R. Maki. Quarterly Econometric Model of the Minnesota and the U.S. Iron Mining Industry. Staff Paper Series P79-41, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. 1979.

2. Kakela, Peter J. Iron Ore: From Depletion to Abundance. Science, 212: 132-136. 1981.

3. Maki, Wilbur R., Patrick D. Meagher, Leonard A. Laulainen, Jr., and Mason Chen. Users' Guide to the Minnesota Regional Development Simulation Laboratory. Staff Paper Series P79-28, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. 1979.

4. Maki, Wilbur R., Patrick D. Meagher and Leonard A. Laulainen, Jr. Economic Effects of Copper-Nickel Development in Northeast Minnesota. Staff Paper Series P79-26, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. 1979.

5. Maki, Wilbur R. Economic Effects of Mineral Resource Development in Northeast Minnesota. Staff Paper Series P80-3, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. 1980.

6. Maki, Wilbur R. Fiscal Effects of Mineral=Related Industry in Minnesota. Staff Paper Series P80-13, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul. 1980.

7. Meagher, Patrick D. and Wilbur R. Maki. Economic Importance of the Mineral Industry in Minnesota. Report prepared for the U.S. Department of Interior, Bureau of Mines, Contract No. G0188153. November 1979.

8. Peterson, J.M. and W. Jesswein. Estimating the Direct and Indirect Impacts of Direct Reduction of Steel for Northeastern Minnesota. Paper prepared as part of research project funded through a grant from the Upper Great Lakes Regional Commission by the Mineral Resources Research Center, University of Minnesota, Minneapolis. 1981.

9. U.S. Congress, Office of Technology Assessment. Technology and Steel Industry Competitiveness. U.S. Government Printing Office, Washington, D.C. 1980.

10. U.S. Department of Labor, Bureau of Labor Statistics. Patterns of U.S. Economic Growth, Bulletin No. 1672. U.S. Government Printing Office, Washington, D.C. 1970

11. U.S. Department of Labor, Bureau of Labor Statistics. Employment Projections for the 1908's, Bulletin 2030. U.S. Government Printing Office, Washington, D.C. 1979.