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PERSPECTIVES ON ECONOMIC GROWTH IN NORTHEAST MINNESOTA

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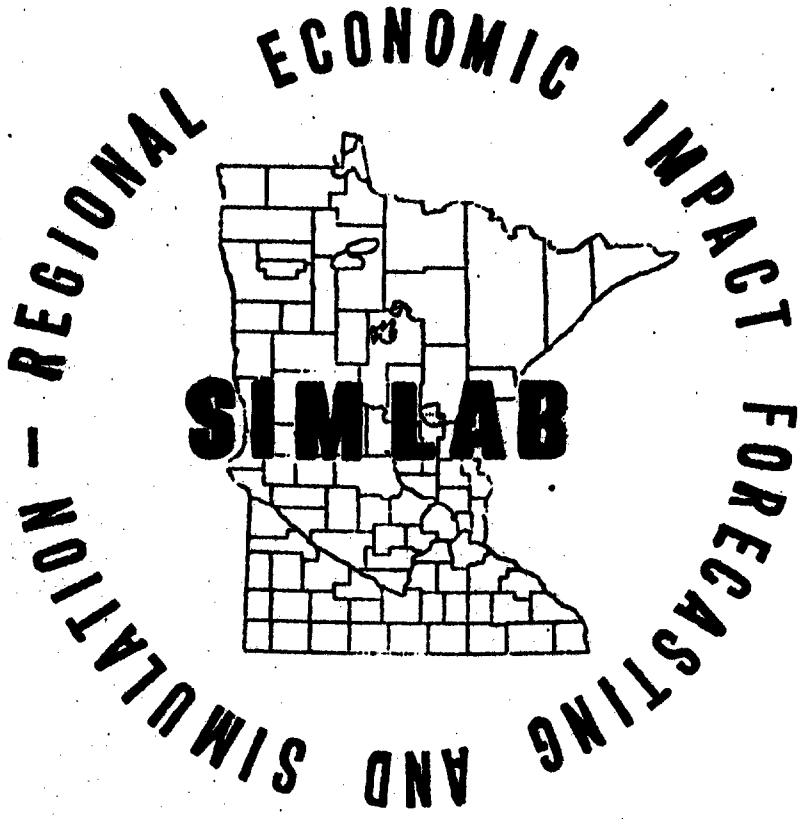

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PERSPECTIVES ON ECONOMIC GROWTH IN NORTHEAST MINNESOTA [1/]

Wilbur R. Maki, Richard W. Lichty and Leonard A. Laulainen, Jr.

This report focuses on the regional economy of Northeast Minnesota and, also, a portion of Northwest Wisconsin.[2/] It covers past trends, current directions of change, and future prospects under varying assumptions. Projected economic impacts of these changes are presented as a basis for discussion of such controversial issues as large-scale mineral exploration and development.

The findings show that the decade of the sixties was characterized by relative economic decline for the region in terms of employment, output and labor productivity. Industrial areas of major concern in this regard included: Agriculture, Forestry, Fisheries, Mining, Other Nondurable Goods Manufacture, Railroads and Railway Express, and Other Transportation. This does not exhaust the list of declining sectors. It merely serves to isolate industries of critical concern in terms of their unique influences on the output and employment of related sectors within the regional economy.

1/ This report is based on data from the Minnesota Economic Impact Forecasting Study which was supported in part by funding from the Minnesota Department of Administration and Minnesota Energy Agency.

2/ Seven counties in the Arrowhead Development Region (Aitkin, Carlton, Cooke, Itasca, Koochiching, Lake and St. Louis Counties, Minnesota) and Douglas County, Wisconsin are included in this designation.

Since 1970, a turnaround in regional economic activity is noted. On the basis of employment information obtained from the Minnesota Department of Employment Services, substantial increases in activity were seen to occur in the Wood Products, Mining, Construction, Railroad and Railway Express and several tourist related industries. This is associated with known expansion in the taconite processing industry currently underway, to changes in the tourist sector as a result of successful efforts aimed at extending the season through the winter months, and finally, to changes in the Wood Products sector as a result of substantial capital improvements in that industry.

These information sources were incorporated into a simulation model for employment, population, energy use, and excess employment. This model, known as SIMLAB, was utilized to make four projection series for the regional economy.

The first of these series, termed Baseline I, projected regional activity to 1985 on the basis of anticipated trends in the United States economy and the predicted effects of these trends on the output of specified regional industrial sectors. The second series, Baseline II, adjusted the 1970 data base utilized in Baseline I by incorporating into the trend analysis independently generated employment estimates for the years 1972 and 1974. The third series, Growth Alternative A, altered the Baseline II results on the basis of appropriate assumptions relating to the closing of a major taconite producer in the region, Reserve Mining Company. The final projection series, Growth Alternative B, adjusted the Baseline II series on the basis of assumed increases in economic activity

associated with the development of copper and nickel mining in the region. In every projection series, the regional economy was simulated in terms of changing levels of excess employment, gross output, population, unemployment, and energy utilization requirements.

Summarizing the findings in terms of excess employment: Baseline I predicted a 3.1 percent increase for the region in this category between the years 1970 and 1985, Baseline II predicted a 12.3 percent increase between those same years, Growth Alternative A predicted a decrease of 3.5 percent increase between those same years, Growth Alternative A predicted a decrease of 3.5 percent and Growth Alternative B predicted an increase of 14.9 percent between 1970 and 1985.

In terms of projected levels of gross output: Baseline I projected an increase of 86 percent in this category between 1970 and 1985 while Baseline II projected an increase of 95 percent in this category during the same period. The difference between these two series reflects the changing nature of the growth pattern within the area between the years 1970 and 1974. Growth Alternative A projected an incraese in gross output of 73 percent and Growth Alternative B predicted an increase of 98 percent for that same fifteen year period.

The projection of the other categories of regional activity, already itemized, generally followed the trends noted above. These additional projections suggested, for example, substantial increases in the energy needs of the regional economy associated with each simulation series. Growth Alternative B resulted in the largest increases in "other"

categories. A representative figure in this regard is a projected 113 percent increase in the electrical energy needs to service expanding regional industries during the fifteen year period. These types of increases, should they materialize as expected, will surely tax existing and planned generating facilities in the region throughout the remainder of this decade and well into the next.

The results of these simulation efforts are instructive in themselves. It is hoped that an appreciation for the use of simulation models for planning, forecasting, and education purposes will be realized in addition to whatever benefits can be obtained directly from the estimates contained in this report. More specifically, this report demonstrated the application of a limited version of SIMLAB, a computer based simulation model that is concurrently operational for the Northeast Minnesota The value of such a system is in its capability for facilitating dialogue between planners, government agencies, and special interest groups as they deal with the many problems that the Northeast Minnesota region faces now or will soon face in the future.

Regional Economy

Despite extreme dependence at times on a volatile primary resource base, Northeast Minnesota is now on the verge of rapid economic diversification. Today, the region faces several growth options in its basic mining and service sectors. These options involve controversial trade-offs between economic growth and environmental preservation.

In this report, the regional economic setting for vieweing the growth vs. environment trade-offs is presented in terms of industry employment and contribution to regional income and gross product.

Recent trends

Several economic indicators show Northeast Minnesota as entering a new period of economic development. Taconite processing facilities are being expanded. Plans for copper-nickel mining are underway. Improvements have been made in the wood products industry partly to reduce adverse environmental impacts and partly to improve the efficiency, and thus, the competitive position of these industries in national and regional markets. New tourist facilities are being built to handle more seasonal residens and also, to provide a wider range of recreational opportunities than currently possible. Construction employment also is increasing as a result of the basic resource development (2, 5, 7, 8). 3/

Northeast Minnesota is part of an extended Arrowhead Region which includes the counties of Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis in Minnesota and, also, Douglas County, Wisconsin. An integral part of this region are, of course, the Twin Cities of Duluth, Minnesota and Superior, Wisconsin. Eight counties, including one Standard Metropolitan Statistical Area, thus make up the extended economic development region (fig. 1).

3/ References cited are listed numerically on p. 40

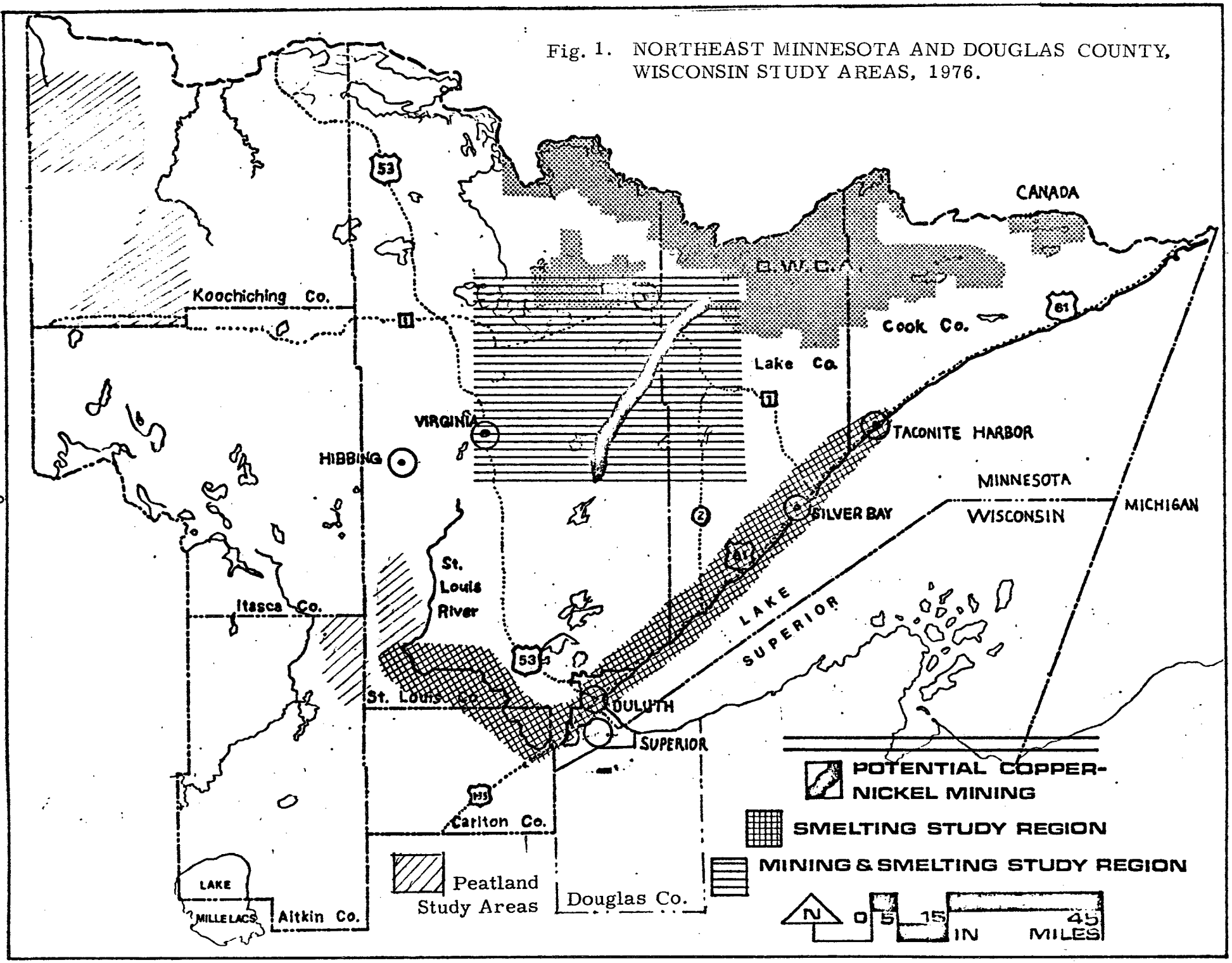

Fig. 1. NORTHEAST MINNESOTA AND DOUGLAS COUNTY, WISCONSIN STUDY AREAS, 1976.

The region is marked by diversity. First, the twin ports of Duluth and Superior a major grain shipping center -- an entreport for the Upper Midwest. Together, the two principal urban centers form a metropolitan focal area of more than 125,000 population. With the municipalities of Cloquet and Two Harbors, they form an extended poly-nucleated metropolitan community with a total population of 145,951, or 33 percent of the total population in the eight-county region.

The twenty-five municipalities on the Mesabi Iron Range, which extend from Babbitt to Coleraine, form another urban focal area with a total population of 63,083, or 17 percent of the total region population of 374,260. The Mesabi Iron Range is the focal area, also, of primary resource development -- taconite and, potentially, copper and nickel. Projected private capital expenditures for primary resource development in the reginn is in excess of two billion dollars, much of it being on the Mesabi Iron Range and the related shipping points on the North Shore.

While the principal transportation facilities for the taconite facilities are on the North Shore of Lake Superior, this area is also an important scenic attraction. Service facilities for tourists on the North Shore account for a substantial share of the economic base of local communities in Lake and Cook counties. Recreation focal areas are identified, also, for the Iron Range as well as the Boundary Waters Canoe Area (BWCA). Intermingling of recreation focal areas with primary resource development

Table 1 Total Industry Employment in Specified Industry, by Place of Residence, Northeast Minnesota and Douglas County, Wisconsin, 1970.

Industry Group	Extended Incorporated Area				Rest of Region	Total
	Duluth Area	Superior Area	Cloquet/ Two Harbors	Total		
1. Agri. Forestry, Fisheries	186	78	107	371	2,575	2,946
2. Mining	246	58	201	505	11,840	12,345
3. Construction	1,838	527	159	2,524	4,426	6,950
4. Furn., Lumber, Wood Prod.	240	92	103	435	2,027	2,462
5. Metal Industries	2,343	293	153	2,789	1,242	4,031
6. Machinery, except Elec.	530	121	27	678	520	1,198
7. Electrical Machinery	184	45	7	236	127	363
8. Transportation Equipment	90	128	7	225	170	395
9. Other Durable Goods	309	123	193	625	771	1,396
10. Food and Kindred Prod.	1,212	261	44	1,517	534	2,051
11. Textiles and Fab.	336	52	23	411	1,066	1,477
12. Printing and Publishing	740	199	36	975	636	1,611
13. Chemicals and Ellied	58	5	10	73	253	326
14. Other Nondurable Goods	298	209	983	1,490	4,476	5,966
15. Railroads and Railway	1,231	1,000	171	2,402	1,742	4,144
16. Trucking, Warehousing	321	132	79	532	585	1,117
17. Other Transportation	788	594	65	1,447	666	2,113
18. Communications	651	150	52	853	576	1,429
19. Utilities and Sanitary Serv.	893	262	78	1,233	1,282	2,515
20. Wholesale Trade	1,898	418	136	2,452	1,842	4,294
21. Food and Dairy Stores	899	400	146	1,445	2,029	3,474
22. Eating and Drinking Places	1,544	704	128	2,376	2,408	4,784
23. Other Retail Trade	4,611	1,265	463	6,339	6,975	13,314
24. Financing, Ins. & Real Estate	1,835	331	124	2,290	1,499	3,789
25. Business and Repair Serv.	931	188	71	1,190	1,237	2,427
26. Private Households	594	101	33	728	863	1,591
27. Other Personal Services	1,395	358	62	1,815	2,128	3,943
28. Entertainment and Rec.	350	66	11	427	349	776
29. Health Services	3,816	1,129	398	5,343	4,723	10,066
30. Public Schools, Colleges	2,647	968	389	4,004	5,487	9,491
31. Private schools, colleges	1,046	283	59	1,388	1,014	2,402
32. Welfare, Religious, Nonprofit	1,167	211	67	1,445	1,041	2,486
33. Legal, Eng., Misc. Prof.	865	222	65	1,152	934	2,086
34. Public Administration	2,360	644	180	3,184	2,875	6,059
Total	38,452	11,617	4,830	54,899	70,918	125,817

areas contribute to land use conflicts and increasing need for some forms of regionwide land use planning.

Industry Employment

To show the importance of the basic industries cited earlier to the total economy of the eight-county region, data from the most recent U. S. Census of Population data are presented. A total of 34 industry groups is identified (table).

Employment in the 34 industry groups in the eight-county region is differentiated by industry as well as place of residence of employed persons. Much of the employment related to urban infrastructure (sectors 15-19) and high-order services (sectors 24 and 28-34) is in the Duluth-Superior urbanized area while much of the employment relating to primary resource development (sectors 1-4 and 14) is in the rest of region.[4/] Convenience services, including retail stores, are located close to the population they service and, thus, a substantial part of these industries (sectors 20-23 and 25-27) is located outside the extended four-city incorporated area.

Substantial percentage and, also, absolute changes in area and regional employment have occurred from 1960 to 1970. For example, transportation employment declined while employment in professional services increased. In the case of transportation, the Duluth-Superior

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4/ Employment in the paper and pulp industries is included in Sector 14.

area experienced a decline, both locally and in terms of national averages. In service activities, the Duluth-Superior area expanded, but so did employment in these activities elsewhere in the Nation. Changes in the distribution of employment by industry thus may or may not be significant to the region's economic base. Much depends on what happens in the Nation as a whole and what occurs as a consequence of these changes in regional specialization and regional advantage in particular industries. For these reasons, industry employment in the eight-county region is viewed in terms of the sources of employment change.

Total employment change is partitioned into three components -- national growth, industry mix and regional share. The national growth coefficient is represented by the percentage change in total employment in the Nation, which, during the 1960-70 period, was 18 percent, or the equivalent of a 22,976 increase in total employment in the Study Region (as shown under "National Growth" in table 2). The industry-mix coefficient is represented by the differential change in employment (i.e., from total employment) in a given industry for the Nation; if the percentage change is larger thatn the national average, then the industry is an above-average growth industry and the industry-mix coefficient is positive. If the industry employment change is less than the national average, the industry is a below-average growth industry, and the industry-mix coefficient is negative. For example, employment in the legal, engineering and miscellaneous professional industry increased

Table 3. Estimated total civilian employment, by change component, Northeast Minnesota and Douglas County, Wisconsin, 1960-70.

Industry Number		Estimated 1960	Change, 1960-1970				Estimated 1970
			National Growth	Relative Change: Industry Mix	Relative Change: Regional Share	Total Change	
			(number)				
1.	Agri. Forestry, Fisheries	5,762	1,062	-3,213	-665	-2,816	2,946
2.	Mining	15,997	2,948	-4,139	-2,461	-3,652	12,345
3.	Construction	6,262	1,155	-216	-251	688	6,950
4.	Furn., Lumber, Wood Prod.	2,446	451	-745	310	16	2,462
5.	Metal Industries	4,132	760	-677	-184	-101	4,031
6.	Machinery, except Elec.	706	130	24	338	492	1,198
7.	Electrical Machinery	254	46	11	52	109	363
8.	Transportation Equipment	430	79	- 22	- 92	- 35	395
9.	Other Durable Goods	1,338	371	508	-821	58	1,396
10.	Food and Kindred Prod.	3,043	560	-261	-1,291	-992	2,051
11.	Textiles and Fab.	942	174	-181	542	535	1,477
12.	Printing and Publishing	1,985	366	-1,032	292	-374	1,611
13.	Chemicals and Ellied	175	32	- 16	135	151	326
14.	Other Nondurable Goods	6,396	1,179	5,775	-7,384	-430	5,966
15.	Railroads and Railway	7,576	1,396	-4,055	-773	-3,432	4,144
16.	Trucking, Warehousing	1,463	270	- 66	-550	-346	1,117
17.	Other Transportation	2,233	412	35	-567	-120	2,113
18.	Communications	1,184	218	87	- 60	245	1,429
19.	Utilities and Sanitary Serv.	2,102	388	394	-369	413	2,515
20.	Wholesale Trade	3,882	715	677	-980	412	4,294
21.	Food and Dairy Stores	3,616	661	-354	-449	-142	3,474
22.	Eating and Drinking Places	3,867	713	156	48	917	4,784
23.	Other Retail Trade	12,158	2,241	985	-2,170	1,156	13,314
24.	Financing, Ins. & Real Estate	3,438	634	628	- 911	351	3,789
25.	Business and Repair Serv.	2,276	419	552	-820	151	2,427
26.	Private Households	3,161	583	-1,962	-191	-1,571	1,591
27.	Other Personal Services	3,865	639	25	-586	78	3,943
28.	Entertainment and Recr.	694	128	14	- 60	82	776
29.	Health Services	4,880	899	1,933	2,354	5,186	10,066
30.	Public Schools, Colleges	6,625	1,221	2,985	1,340	2,866	9,491
31.	Private Schools, Colleges	1,218	225	1,048	89	1,184	2,402
32.	Welfare, Religious, Nonprofit	1,943	358	238	53	543	2,486
33.	Legal, Eng., Misc. Prof.	2,605	480	3,417	-4,416	- 519	2,086
34.	Public Administration	5,770	1,063	430	-1,204	289	6,059
	Total	124,424	22,976	2,983	-24,566	1,393	125,817

by 150 percent in the Nation in the period from 1960 to 1970; this is an above-average growth industry -- 122 percent above total industry employment -- and the industry-mix effect is strongly positive. The private household industry, on the other hand, experienced a 44 percent decline in total employment -- 62 percent below total industry employment -- and, hence, the industry-mix effect is strongly negative. Other industries, which ranged between these two industries in their industry-mix coefficient, thus accounted for the slight positive industry-mix effect in the Study Region.

Finally, the regional-share coefficient is represented by the differential change in employment (i.e., from total employment) in a given industry in the Nation. For example, wood products manufacturing, though a below-average growth industry in the Nation, experienced a net increase of 16 in employment from 1960 to 1970 in the Study Region, and hence, it is represented by a positive regional-share coefficient. If the growth in this industry in the region had been at the national average for the wood products industry, a net decline of 294 rather than a net increase of 16 would have occurred in total employment.

The regional share-coefficient, when multiplied by base-year total employment in the region, yields the regional-share effect. Similarly, multiplying the national growth and industry-mix coefficients by total base-year employment yields the national-growth effect and industry-mix effect, respectively. The numerical results of these computations were cited earlier.

Because of the region's dependency on below-average growth resource-based industries, local service industries in the region have failed to keep pace with national industry growth. The negative industry-mix effect, coupled with the generally negative regional-share effects for the local service industries help explain the lagging overall growth rates for industry employment in the 1960-70 period. As the resource-dependent industries decline in relative importance in the region's economic base, or as the service-dependent industries achieve higher rates of growth, the above-average growth industries will emerge as principal sources of regional economic growth. However, the growth of these industries is limited by the region's economic base.

Comparison of the percentage distribution of total employment in each in the Study Region and the United States for 1960 and 1970 shows changes in the relative importance of particular industries. Given the U.S. industry employment profile as a base, then the difference in the percentage of total employment accounted for by a given industry is an approximate measure of its importance in the regional economy. A positive difference between the Study Region and the U.S. employment profile denotes an above-average percentage of total employment which is viewed as an approximate measure of export-producing employment, i.e., the industry employment engaged in producing goods and services for sale to buyers who reside outside the region.

Total excess employment, using the U.S. industry employment as the standard of reference, declined in the Study Region (as it has

generally within the U.S.). Total excess employment declined from 23.4 percent of employment from 1960 to 1970 (table 3).

The mining industry accounted for more than one-half of the total excess employment in both 1960 and 1970. The timber-related industries (sectors 4 and part of 14) were important, too. Most important in maintaining the regional basehas been the growth of the Health Services Industry. Much of the resource-based excess employment was outside the Duluth-Superior area. This dichotomy was accentuated during the 1960-1970 period, with rapid expansion of the health care industry (sector 29) in the Duluth area.

After a period of relative stability in the 1960's, the Study Region is now experiencing potentially rapid economic change. Large-scale capital outlays are being planned in both the private and public sectors. These capital expenditures will create additional job opportunities within the next five years and over a longer time period. Initially, the new construction activity will mean more construction workers employed in the region. Later, additional production workers will be employed in the mining, wood products and related manufacturing industries. Expansion of tourist activities in the region also will result in new job opportunities.

Northeast Minnesota and Douglas County, Wisconsin are natural resource-dependent economies in which taconite, timber, trade and transportation provide much of the basic industry employment. However, service industries are expanding, especially health care and education, which are localized in the Duluth-Superior area. A viable export base supports

Table 3. Estimated excess employed labor force in specified industry groups, Northeast Minnesota and Douglas County, Wisconsin, 1970.

No.	Industry Title	Total Employment			Excess Employment			
				Change	Total		Proportion of Total	
		1960	1970	1960-70	1960	1970	1960	1970
		(no.)	(pct.)	(pct.)	(no.)	(no.)	(pct.)	(pct.)
1.	Agri. Forestry, Fisheries	5,762	2,946	- 48.9	0	0	0	0
2.	Mining	15,997	12,345	- 22.8	14,685	11,308	50.5	50.8
3.	Construction	6,262	6,950	11.0	0	0	0	0
4.	Lumber, Furniture	2,446	2,462	0.6	306	854	1.1	3.8
5.	Metal Industries	4,132	4,031	2.4	0	0	0	0
6.	Machinery, Elec.	706	1,198	69.7	0	0	0	0
7.	Electrical Machinery	254	363	42.9	0	0	0	0
8.	Transportation Equip.	430	395	- 8.1	0	0	0	0
9.	Other Durable Goods	1,338	1,396	4.3	0	0	0	0
10.	Food and Kindred Prod.	3,043	2,051	- 32.6	0	0	0	0
11.	Textiles and Fab.	942	1,477	56.8	0	0	0	0
12.	Printing and Publishing	1,985	1,611	- 18.8	0	0	0	0
13.	Chemicals & Allied Prod.	175	326	86.3	0	0	0	0
14.	Other Nondurable Goods	6,396	5,966	- 6.7	4,236	2,116	14.6	9.5
15.	Railroads and Railway	7,576	4,144	- 45.3	5,688	3,098	19.6	12.1
16.	Trucking, Warehousing	1,463	1,117	- 23.6	0	0	0	0
17.	Other Transportation	2,233	2,113	- 5.4	454	290	1.6	1.1
18.	Communications	1,184	1,429	20.7	0	0	0	0
19.	Utilities & Sanitary Serv.	2,102	2,515	19.6	303	405	1.0	1.6
20.	Wholesale Trade	3,882	4,294	10.6	0	0	0	0
21.	Food & Dairy Stores	3,616	3,474	- 3.9	230	331	0.8	1.3
22.	Eating & Drinking Plac	3,867	4,784	23.7	256	1,005	0.9	3.9
23.	Other Retail Trade	12,158	13,314	9.5	0	120	0	0.5
24.	Financing, Ins. & Real Est.	3,438	3,789	10.2	0	0	0	0
25.	Business & Repair Serv.	2,276	2,427	6.6	0	0	0	0
26.	Private Households	3,161	1,591	- 49.7	0	0	0	0
27.	Other Personal Serv.	3,865	3,943	2.0	0	0	0	0
28.	Entertainment & Rec.	694	776	11.8	0	0	0	0
29.	Health Services	4,880	10,066	106.1	0	3,087	0	12.1
30.	Public Schools, Colleges	6,625	9,491	43.3	1,553	2,386	5.3	9.3
31.	Private Schools, Colleges	1,218	2,402	97.2	0	0	0	0
32.	Welfare, Relig., Non-pr.	1,943	2,486	28.0	232	574	0.8	2.2
33.	Legal, Eng., Misc. Prof.	2,605	2,086	- 20.0	1,110	0	3.8	0
34.	Public Administration	5,770	6,059	5.0	0	0	0	0
	Total	124,409	125,819	1.1	29,053	25,573	100.0	100.0

an expanding service sector in the regional economy. The interdependence of the basic and service sectors is revealed by a table of interindustry transactions which has been prepared for the eight-county region (8).

Growth Determinants

Determinants of economic growth in the Study Region are identified first, in terms of the market outlook for the region's export base (as represented by the market share of each export-producing industry) and local investment. A table of interindustry transactions for the study regions presents one indicator of economic growth -- industry gross output -- and a series of related indicators, including employment, earnings, and expenditures (as compared with the 34-industry breakdown shown earlier) of the regional economy. The 35-industry groups are compiled from the 1970 U.S. input-output tables to which the regional tables are keyed (10).

Market outlook

The market outlook for the region's export base is conditioned, in large part, by the U.S. economy and its expanding requirements for the industry output originating in the Study Region. For the 1970-85 period. all but two industry groups are projected to expand in total market requirements (table 4). Projected annual change in national market requirements (in column 6) vary greatly by industry because of differences in both intermediate and final demand requirements. Thus, given the regional share of a particular industry market (in column 7), the national growth is translated into proportional regional growth. However,

Table 4. Output per worker, annual change in output per worker, annual change in U.S. output, regional share, projected regional share, and annual change in regional share, Northeast Minnesota and Douglas County, Wisconsin, 1970-1985.

	INDUSTRY	OUTPUT PER WORKER			U.S. GROSS OUTPUT			REGIONAL MARKET SHARE		
		1970	1985	ANNUAL CHANGE	1970	1985	ANNUAL CHANGE	1970	1985	ANNUAL CHANGE
		(dol.)	(dol.)	(pct)	(mil. dol)	(mil. dol)	(pct)	(dol.)	(dol.)	(pct)
1	LIVESTOCK	22122.	50208.	5616	37503.	51865.	1058	.00000	.00000	0
2	CROPS	16388.	37769.	5724	30194.	44264.	0267	.00000	.00000	0
3	OTHER AGRI	29078.	38814.	1944	5294.	7724.-	2019	.03561	.03358 -	0391
4	IRON, FERR	48532.	91525.	4320	1930.	3028.	1862	.33210	.57325	3706
5	NON-FERROU	18826.	30372.	3240	3112.	5039.-	7237	.00000	.00000	0
6	OTHER QUAR	18338.	22604.	1404	26421.	29537.	2170	.00000	.00000	0
7	CONSTRUCTI	36329.	55911.	2916	127717.	204259.	0474	.00018	.00075	9998
8	FOOD AND K	78125.	128033.	3348	105043.	145099.	1371	.00105	.00007 -	16696
9	LUMBER, FU	33031.	56734.	3672	25148.	43501.	1942	.00278	.00547	4618
10	PULP AND P	33843.	57227.	3564	26820.	46811.	1681	.03601	.05269	2570
11	PRINT AND	17785.	31516.	3888	26001.	39276.	2516	.00000	.00000	0
12	CHEMICAL,	20882.	45259.	5292	55709.	115139.	3630	.00000	.00000	0
13	PETROL, RE	169083.	420622.	6264	31764.	49863.	2531	.00047	.00001 -	22315
14	STONE, CLA	18129.	25784.	2376	17498.	27734.	2345	.00000	.00000	0
15	PRIMARY ME	31834.	58197.	4104	61105.	97683.	5034	.01447	.00003 -	33089
16	FABRIC, ME	22090.	33466.	2808	43462.	77419.	3057	.00000	.00000	0
17	MACHINERY	27790.	54904.	4644	64804.	135475.	3324	.00000	.00000	0
18	ELECTRICAL	51176.	105906.	4968	54883.	108929.	3056	.00000	.00000	0
19	OTHER MANU	21437.	42352.	4644	196354.	365011.	1955	.00000	.00000	0
20	RAILROAD	14213.	27649.	4536	14937.	20311.	1937	.00726	.00820	0811
21	TRUCKING	5783.	7843.	2052	20213.	33717.	1591	.00000	.00000	0
22	OTHER TRAN	60442.	105449.	3780	30526.	62552.	3399	.00183	.00846	10746
23	COMMUNICAT	22375.	51566.	5724	29568.	64708.	4537	.00000	.00000	0
24	ELECTRIC U	79891.	153021.	4428	31545.	66031.	3561	.00312	.00687	5402
25	GAS UTILIT	83475.	118721.	2376	11740.	15091.	2054	.00000	.00000	0
26	OTHER UTIL	111388.	132976.	1188	4584.	6244.	1423	.00056	.00178	8006
27	WHOLESALE	10255.	23634.	5724	81503.	142111.	2763	.00000	.00000	0
28	RETAIL	5222.	8693.	3456	125505.	205874.	2227	.00000	.00000	0
29	F.I.R.E.	40604.	57749.	2376	208658.	353701.	2384	.00000	.00000	0
30	HOTELS, PE	9809.	15096.	2916	23686.	34858.	1235	.00000	.00000	0
31	BUSINESS S	9489.	13496.	2376	68991.	131028.	2277	.00000	.00000	0
32	MEDICAL,	8332.	13655.	3348	68614.	124052.	2524	.00000	.00000	0
33	OTHER SERV	1612.	2186.	2052	49078.	79132.	1002	.00000	.00000	0
34	FED. GOVT.	3329.	5899.	3888	9809.	17819.	2519	.00031	.00039	1532
35	STATE-LOCA	6711.	11892.	3888	11855.	20052.	1711	.00000	.00000	0
36	TOTALS	33936.	61049.	3681	1731634.	2974939.	1890	.01245	.01976 -	0717

the regional share of each industry is likely to vary from its 1970 level (as indicated in colums 8 and 9).

Labor productivity

Labor productivity is important, also, in accounting for regional economic growth. Output per worker levels in the Study Region which were derived for the base year, 1970, are projected to increase substantially over the 1970-85 period (as shown in columns 1, 2 and 3). The projected levels again are based on U.S. employment and output series prepared by the U.S. Bureau of Labor Statistics for its economic growth studies. The projected U.S. productivity rate, i.e., the projected annual change in output per worker, has been revised slightly downward nationally and, also, for use in this study (as shown in column 3). The revised productivity rates are consistent with the reduced levels of increase which are anticipated in the most recent U.S. output-per-worker projections.

With the annual growth in demand for regional industry output lags behind the annual growth in regional industry employment, a decline occurs in total industry employment. Thus, the interaction between a market growth and productivity has important consequences for the Study Region. The regional model, of course, provides for this interaction and makes possible a systematic appraisal of both market and productivity (i.e., technological and labor-reducing investment/imports upon industry output and employment).

Local investment and energy utilization

Local investment is still another important determinant of regional economic growth. Industry expansion depends on investment. Most industry invests to maintain and to expand production. In the current study, however, the two types of investment are not differentiated, nor is the total level of investment, in terms of production capacity and its utilization, included in the data base. Rather, the increase in gross output is related directly to the equivalent facilities and related capital stock required for production. In short, existing capacity is viewed as being fully utilized, which, of course, is the case for only a few industries, such as being fully utilized, which, of course, is the case for only a few industries, such as iron mining in its peak years of production.

Projected output levels for 1974 and 1985 provide the base-year and target-year for the comparisons with a survey findings on capital expenditures in a related study (8). Except for iron mining, pulp and paper products manufacturing, and electric utilities, projected capital requirements for the 1970-1980 period greatly exceed anticipated capital expenditures (table 5). Most businesses are unlikely to expand facilities until warranted by a sustained high level of market demand. Expected increases in capital outlays in several basic industries are sufficiently large, however, to severely tax existing facilities as a result of the expansion in construction and related population. Especially vulnerable are the energy-providing and distributing facilities as well as public facilities, such as schools and hospitals.

Table 5. Projected increases in gross output, capital expenditures and employment in selected industries, Northeast Minnesota and Douglas County Wisconsin, 1975-1980. 1/

Sector No.	Title	Gross Output	Capital Expenditures 2/	Employment
		(thou. dol.)	(thou. dol.)	(no.)
1.	Livestock	13343	14669	-129
2.	Crops	6962	8702	-67
3.	Other agriculture	2028	1602	-5
4.	Mining: ferrous	351476	527179	2635
5.	Non-ferrous	972	1652	24
6.	Quarrying	1198	1411	45
7.	Construction	125770	35379	1902
	Manufacturing:			
8.	Food and kindred	76649	33894	158
9.	Lumber, furn.	25019	10398	153
10.	Pulp, paper	43173	33697	1
11.	Printing, publ.	12968	8300	252
12.	Chemical	1817	1520	4
13.	Petro. refining	21300	17040	-13
14.	Stone, clay, glass	4027	2879	129
15.	Primary metal	49490	31139	495
16.	Fabr. metal	8784	3848	177
17.	Machinery, exc. elect.	9042	4180	25
18.	Electrical machinery	4375	1316	-10
19.	Other manufacturing	16696	5698	22
	Regulated industries:			
20.	Railroad	17356	56407	-67
21.	Trucking	2205	771	202
22.	Other transportation	40504	56199	197
23.	Communications	12579	28293	6
24.	Electric utilities	34267	181615	66
25.	Gas utilities	6071	14873	37
26.	Other utilities	2717	4510	18
	Trade and service:			
27.	Wholesale	29020	31899	50
28.	Retail	57113	62778	3819
29.	Finance, ins., real estate	94697	18200	1270
30.	Hotels, personal	26077	36507	1378
31.	Business, repair	8843	4244	488
32.	Medical, educ.	57274	100229	2935
33.	Other services	6838	14650	1242
34.	Federal gov't. enter.	5762	3/	443
35.	State-local enter.	6117	3/	208
TOTALS		1182529	1355878	18090

1/ Based on Growth Projection II

2/ Based on Battelle Memorial Institute Research Report, "on Ex Ante Capital Matrix for the United States, 1970-75", March 31, 1971.

3/ Data not available

Alternative Futures

Alternative futures for the Study Region are postulated with different sets of market-share assumptions. Two baseline and two growth options are presented. Because of differences in the two baseline projections, they are noted as Baseline Projection I and Baseline Projection II. Historical rates of change are incorporated into both regional baseline projection series.

Baseline projection series

The two-step procedure used in the derivation of the baseline projections starts with the 1970 data base. An initial projection series, i.e., Baseline I, is prepared. This series differs from the independently-derived employment estimates, which are based on Minnesota Department of Employment Services reports (table 6). The new estimates were not available, of course, in the preparation of the 1970 data base.

Adjustment of the Baseline I projections to the independently-derived employment estimates for 1972 and 1974, results in a new projection series, namely, Baseline II. The new baseline series now incorporates the more recent historical data. For the historical period since 1970, the two estimated and projected Baseline II series theoretically are identical and, hence, the Baseline II series is shown only for 1985. 5/

5/ Baseline II is the user-adjusted series which corrects for over - or under - projection of target variables by parameter-changes as indicated.

Table 6. Estimated and projected employment in specified industry groups, by type of projection, Northeast Minnesota and Douglas County, Wisconsin, 1970-1985.

Industry Group	Estimated			Projected										
				Baseline I				Baseline II		Growth 'A'		Growth 'B'		
	1970	1972	1974	1972	1974	1980	1985	1980	1985	1980	1985	1980	1985	
	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	
1. Livestock & livestock prod.	2016	1970	1905	2072	1905	1573	1379	1203	1107	1149	1025	1207	1125	
2. Other agric. products	1283	1253	1227	1335	1227	1017	897	1037	944	991	873	1040	958	
3. Agri. services, for., fish.	576	583	555	580	555	514	497	539	530	527	510	542	535	
4. Iron & ferro alloy ores	11601	11951	12352	11879	12163	13056	13851	13160	13964	9873	10476	13161	13965	
5. Nonferrous metal ores	86	71	65	89	92	102	112	96	106	74	81	96	533	
6. Other mining, quarrying	148	114	81	164	169	191	215	190	217	177	199	192	220	
7. Construction	4193	4906	5118	4140	4007	3715	3533	4687	4419	4547	4251	4944	4530	
8. Food & kindred products	3340	2556	2310	3581	3438	3225	3139	2364	2430	2259	2249	2372	2468	
9. Lumber & furniture	2080	2627	2462	2128	2069	1968	1907	2663	2576	2610	2507	2684	2595	
10. Pulp & paper products	5234	4689	5761	5264	5177	5002	4881	5862	5741	5819	5680	5867	5753	
11. Printing & publishing	1240	1390	1497	1450	1399	1476	1558	1516	1655	1415	1535	1524	1679	
12. Chemicals & allied prod.	204	59	67	211	201	182	171	114	109	103	97	115	110	
13. Petroleum refining	314	273	280	321	297	250	221	240	215	227	200	241	218	
14. Stone, clay & glass	348	291	503	362	356	354	359	365	368	351	329	379	375	
15. Primary metals	3310	2225	931	3317	3284	3225	3198	1829	1835	1600	1584	1850	1857	
16. Fabricated metals	700	644	979	727	715	708	714	812	824	779	779	830	836	
17. Machinery exc. electrical	859	831	1166	853	834	788	757	993	950	941	893	996	958	
18. Electrical manufactures	284	305	201	283	269	237	217	178	163	173	157	179	165	
19. Other manufacturing	2177	2136	3447	2353	2232	2051	1943	2816	2706	2704	2558	2824	2735	
20. Railroad transportation	4144	4129	3984	4129	3984	3658	3434	3710	3502	3591	3361	3721	3520	
21. Trucking & warehousing	986	1043	1130	1074	1073	1130	1204	1145	1239	1086	1154	1153	1253	
22. Other transportation	1422	458	2653	1485	1491	1549	1613	2815	2925	2642	2729	2817	2935	
23. Communication	1271	1348	1479	1361	1271	1124	1037	1148	1078	1088	1000	1153	1092	
24. Electric utilities	1016	1189	1443	1059	1042	1027	1026	1486	1492	1429	1425	1488	1500	
25. Gas utilities	160	87	110	177	179	194	212	130	147	114	126	131	148	
26. Other utilities	67	79	104	78	79	89	101	109	124	104	117	109	126	
27. Wholesale trade	6316	6277	5672	6708	6242	5472	5006	5233	4874	4936	4507	5267	4944	
28. Retail trade	22469	21660	26385	26230	25278	25440	26235	31040	32792	29381	30269	31209	33353	
29. Finance, ins., real estate	4387	4527	4131	5179	5165	5729	6362	5061	5739	4596	5119	5080	5821	
30. Hotels, pers. & repair serv.	3771	4095	4370	4792	4684	5409	6132	4755	5586	4421	5170	4780	5685	
31. Business services	1943	1477	2225	2127	2141	2316	2514	2358	2589	2135	2306	2373	2612	
32. Medical, educational	11253	12109	11781	13785	13366	14530	15746	13011	14553	12196	13493	13073	14800	
33. Other services	20508	21489	2159	21786	21489	21597	21968	21522	22100	20949	21310	21568	22246	
34. Federal govt. enterprise	3869	4264	4145	4264	4145	4135	4196	4582	4724	4332	4398	4597	4776	
35. State & local govt. ent.	2190	2344	2302	2344	2302	2300	2334	3188	3265	3037	3077	3193	3287	
TOTAL	125279	126549	134418	136862	13418	135335	138666	141957	147589	132354	135944	142754	149714	

1/ Including other government employment

In SIMLAB (which is the computer-based simulation program used in deriving all the projection series in this report), the so-called baseline and growth alternatives are derived from different assumptions about the market shares of particular export-producing industries in the Study Region.[6] For the recent historical period, i.e., 1970 to 1974, the Baseline I market-share and the annual change-in-market-share coefficients (again, based on earlier historical data) are recomputed, as shown in table 7. The new coefficient series yields the Baseline II excess employment projections.[7]

The excess-employment concept is derived from the export-base model of regional economic development. In this model, the export-producing activities require the basic purchasing power of the regional economy. The dollars derived from export trade, i.e., income payments from businesses, and households and governments located outside the region, are turned over several times within the region, thus providing for the economic support of many residentiary activities, Primarily in the trade and services of each local economy. The excess employment as a proportion of total employment is assumed to be identical to the export product value as a proportion of total product value for each industry in the region. Thus, total employment in each industry is partitioned into two components, namely, excess employ-

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6/ See Appendix for discussion of SIMLAB

7/ Post-1975 data are used in validating and, then, correcting the Baseline II projection series.

Table 7. Alternative market share assumptions for specified industry groups, by type of projection, Northeast Minnesota and Douglas County, Wisconsin, 1970-1985.

	Industry	Baseline II						Growth A		Growth B	
		1972	1974	1976	1978	1980	1985	1980	1985	1980	1985
1.	Livestock & livestock prod.	0	0	0	0	0	0	0	0	0	0
2.	Other agric. products	0	0	0	0	0	0	0	0	0	0
3.	Agri. services, for., fish.	.03533	.03506	.03478	.03451	.03424	.03358	.03424	.03358	.03424	.00358
4.	Iron & ferro alloy ores	.36027	.38695	.41562	.44640	.47947	.57325	.35960	.42994	.47947	.57325
5.	Nonferrous metal ores	0	0	0	0	0	0	0	0	0	.49140
6.	Other mining, quarrying	0	0	0	0	0	0	0	0	0	0
7.	Construction	.00058	.00075	.00075	.00075	.00075	.00075	.00075	.00075	.00091	.00082
8.	Food & kindred products	.00015	.00007	.00007	.00007	.00007	.00007	.00007	.00007	.00007	.00007
9.	Lumber & furniture	.00465	.00509	.00515	.00522	.00529	.00574	.00529	.00547	.00529	.00547
10.	Pulp & paper products	.03210	.04606	.04720	.04837	.04956	.05269	.04956	.05260	.04956	.05269
11.	Printing & publishing	0	0	0	0	0	0	0	0	0	0
12.	Chemicals & allied prod.	0	0	0	0	0	0	0	0	0	0
13.	Petroleum refining	0	0	0	0	0	0	0	0	0	0
14.	Stone, clay & glass	0	0	0	0	0	0	0	0	0	0
15.	Primary metals	.00422	0	0	0	0	0	0	0	0	0
16.	Fabricated metals	0	0	0	0	0	0	0	0	0	0
17.	Machinery exc. electrical	0	0	0	0	0	0	0	0	0	0
18.	Electrical manufactures	0	0	0	0	0	0	0	0	0	0
19.	Other manufacturing	0	0	0	0	0	0	0	0	0	0
20.	Railroad transportation	.00738	.00750	.00762	.00774	.00787	.00820	.00787	.00820	.00787	.00820
21.	Trucking & worehousing	0	0	0	0	0	0	0	0	0	0
22.	Other transportation	.00181	.00761	.00776	.00791	.00806	.00846	.00806	.00846	.00806	.00846
23.	Communication	0	0	0	0	0	0	0	0	0	0
24.	Electric utilities	.00397	.00625	.00636	.00647	.00658	.00687	.00658	.00687	.00658	.00687
25.	Gas utilities	0	0	0	0	0	0	0	0	0	0
26.	Other utilities	.00072	.00149	.00154	.00159	.00164	.00178	.00164	.00178	.00164	.00178
27.	Wholesale trade	0	0	0	0	0	0	0	0	0	0
28.	Retail trade	0	0	0	0	0	0	0	0	0	0
29.	Finance, ins., real estate	0	0	0	0	0	0	0	0	0	0
30.	Hotels, pers. & repair serv.	0	0	0	0	0	0	0	0	0	0
31.	Business services	0	0	0	0	0	0	0	0	0	0
32.	Medical, educational	0	0	0	0	0	0	0	0	0	0
33.	Other services	0	0	0	0	0	0	0	0	0	0
34.	Federal govt. enterprise	.00032	.00033	.00034	.00035	.00036	.00040	.00036	.00039	.00036	.00039
35.	State & local govt. ent.	0	0	0	0	0	0	0	0	0	0

ment and residentiary employment, but in this case the final demand sectors in SIMLAB provide the data series rather than the U.S. Census of Population estimates of Employment (as in table 2). Great variability occurs among industries in the distribution of total employment between export-producing and residentiary whether final demand or the employment approaches are used in the estimation procedure.

The percentage adjustments in the preceding step are converted into corresponding absolute adjustments of the excess employment projections in the computational procedures (table 8). Each projection series differs in its excess employment levels for one or more industries. Again, the Baseline II series is not given inasmuch as it will correspond exactly with the reported employment estimates for 1972 and 1974. However, the excess employment estimates are derived indirectly, unlike their 1970 counterparts, from the Baseline I projections. Thus, an excess employment estimate is entered for industries which are shown as being entirely residentiary, e.g., printing and publishing, to account for the employment increase which exceeds the projected residentiary requirements. A positive excess employment estimate (in parentheses) for the totally residentiary industries indicates a higher-than-projected level of local purchases. A negative excess employment estimate for these industries indicates a lower-than-projected level of local purchases. For the export-producing industries, the given employment estimate represents the adjusted excess employment in the Baseline II series.

Table 8. Estimated and projected excess employment in specified industry groups, by type of projection, Northeast Minnesota and Douglas County, Wisconsin, 1970-1985.

	Industry	Estimated			Projected							
					Baseline I			Baseline II	Growth A		Growth B	
		1970	1972	1974	1972	1974	1985	1985	1980	1985	1980	1985
1.	Livestock & livestock prod.	0	(26)	0	0	0	0	0	0	0	0	0
2.	Other agric. products	0	(20)	0	0	0	0	0	0	0	0	0
3.	Agri. services, for., fish.	322	319	319	295	271	168	168	208	168	208	168
4.	Iron & ferro alloy ores	10935	11265	11645	11198	11467	13069	13199	12438	13199	9328	9900
5.	Nonferrous metal ores	0	0	0	0	0	0	0	0	419	0	0
6.	Other mining, quarrying	0	0	0	0	0	0	0	0	0	0	0
7.	Construction	369	1163	1454	352	335	258	1075	1464	1174	1210	1075
8.	Food & kindred prod.	955	148	0	909	865	659	46	52	46	52	46
9.	Lumber & furniture	601	1151	1299	589	577	516	919	967	919	967	919
10.	Pulp & paper products	3157	2615	3693	3119	3081	2880	3508	3617	3508	3617	3508
11.	Printing & publishing	0	(108)	(128)	0	0	0	0	0	0	0	0
12.	Chemicals & allied prod.	0	0	0	0	0	0	0	0	0	0	0
13.	Petroleum refining	40	10	28	38	36	26	1	1	1	1	1
14.	Stone, clay & glass	0	0	(153)	0	0	0	0	0	0	0	0
15.	Primary metals	1147	30	0	1134	1122	1054	3	3	3	3	3
16.	Fabricated metals	0	0	(274)	0	0	0	0	0	0	0	0
17.	Machinery exc. electric	0	0	(326)	0	0	0	0	0	0	0	0
18.	Electrical manufactures	0	(30)	0	0	0	0	0	0	0	0	0
19.	Other manufacturing	0	0	(1298)	0	0	0	0	0	0	0	0
20.	Railroad transportation	2247	2176	2098	2171	2098	1738	1738	1893	1738	1893	1739
21.	Trucking & warehousing	0	(30)	(92)	0	0	0	0	0	0	0	0
22.	Other transportation	367	380	1552	372	376	402	1607	1560	1607	1560	1607
23.	Communication	0	(105)	(270)	0	0	0	0	0	0	0	0
24.	Electric utilities	447	616	869	447	447	448	868	867	868	867	868
25.	Gas utilities	0	0	0	0	0	0	0	0	0	0	0
26.	Other utilities	9	18	39	9	10	12	29	27	29	27	29
27.	Wholesale trade	0	(-68)	0	0	0	0	0	0	0	0	0
28.	Retail trade	0	(1315)	(3107)	0	0	0	0	0	0	0	0
29.	Finance, ins., real estate	0	0	0	0	0	0	0	0	0	0	0
30.	Hotels, pers. & repair serv.	0	(4)	(19)	0	0	0	0	0	0	0	0
31.	Business services	0		(147)	0	0	0	0	0	0	0	0
32.	Medical, educational	0	(292)	0	0	0	0	0	0	0	0	0
33.	Other services	0	0	0	0	0	0	0	0	0	0	0
34.	Federal govt. enterprise	170	170	170	170	171	175	175	173	175	173	175
35.	State & local govt. ent.	0	0	0	0	0	0	0	0	0	0	0
	Total	20765	21991	26882	20803	20856	21405	23336	23271	23855	19908	20037

They are calibrated to the more recent post-1970 data base.

The actual re-calibration of the Baseline I series is limited to the export-producing industries in 1970. For several of these industries, the post-1970 experience exceeded, at times, the pre-1970 expectations, e.g., construction, lumber, pulp and paper, other transportation, electric utilities. However, two of the export-producing industries -- food products and primary metals manufacturing -- experienced sharp cutbacks in sales and employment. In addition, several totally residentiary industrues in 1970 experienced growth in sales and employment.which greatly exceeded the baseline projection levels, e.g., other manufacturing and retail trade. Additional study is needed, however, to establish new base-year estimates of the level of export sales in each of the two, and perhaps, other, sectors.

In the SIMLAB re-calibration, the industry market share adjustments are entered in two series of parameters -- the regional market share and the annual rate of change in the regional market share. (The latter coefficient, is shown for the Baseline II projections in table 4). For example, in the Baseline II series, export-related construction activity is increased 329 percent, which thus increases so-called excess employment from 354 to 1,163 in 1972. In the actual re-calibration, the adjusted 1972 market share is increased, again, with the re-calibration of the annual-change-of-market share coefficient. Thus, the fully adjusted forecast is increased a total of 434 percent (from its 1974 Baseline I level of 335).

The 1972 and 1974 employment estimates are used similarly in the re-calibration of the market-share coefficients of other export-producing industries in the Study Region. For example, food and kindred products manufacturing and, also, primary metal manufacturing experienced a virtual disappearance of their export market sales by 1974 (Table 9). The Baseline II projections are adjusted to the new employment levels.

Sectors which experienced increases in export sales in 1974 include lumber and related wood products manufacturing; pulp and paper products manufacturing; printing and publishing; other manufacturing; other transportation; electric utilities; retail trade; hotels, motels, and personal services; and business and repair services. The expanding service sectors, including transportation, acquire their viability from the growing importance of both tourist and lake port activities.

The Baseline II re-calibration procedures include an additional series of changes for the post-1975 period. First, the annual change in the regional market-share of the taconite industry increased by 50 percent (to 10.9 percent), which results in a net increase of 1,612 in total employment for the 11-year period from 1974 to 1985. During this period, output per worker is increased four percent annually, which works counter to the positive effects of market expansion by reducing total employment requirements nearly 30 percent from the given 1974 level of industry output. Labor productivity gains thus significantly temper the total employment impacts of the large projected capacity expansion in the taconite industry.

Finally, the regional share and the annual change in regional share

Table 9. Estimated and projected gross output for specified industry groups, by type of projection, Northeast Minnesota, and Douglas County, Wisconsin, 1970-1985.

	Industry Group	Estimated	Projected							
			Baseline I			Baseline II		Growth A		Growth B	
		1970	1972	1974	1985	1980	1985	1980	1985	1980	1985
						($1,000)					
1.	Livestock & livestock prod.	44597	51127	52438	69194	45952	55604	43880	51443	46110	56469
2.	Other agric. products	21026	24448	25119	33872	29638	35646	28327	32982	29746	36193
3.	Agri. services, for., fish.	16749	17518	17444	19295	19006	20581	18572	19813	19098	20759
4.	Iron & ferro alloy ores	563024	627390	699072	1267738	974916	1278089	731433	958842	974946	1278162
5.	Nonferrous metal ores	1619	1779	1958	3404	2494	3234	1905	2461	2496	6200
6.	Other mining, quarrying	2714	3100	3268	4861	4015	4915	3734	4496	4041	4968
7.	Construction	152326	159313	163317	197513	226967	247097	220192	237685	239421	253294
8.	Food & kindred prod.	261562	298800	306388	401932	256686	311077	245314	287986	257562	315967
9.	Lumber & furniture	68969	75548	78963	108169	126145	146137	123664	142255	127155	147197
0.	Pulp and paper products	177134	191081	201552	279310	281563	328513	279515	325049	281798	329237
1.	Printing & publishing	22054	27835	28980	49107	39495	52144	36847	48365	39693	52928
2.	Chemicals & allied prod.	4260	4889	5152	7720	3998	4933	3612	4396	4021	4999
3.	Petroleum refining	53092	61324	64092	92755	74382	90417	70576	84058	74840	91537
4.	Stone, clay & glass	6309	6877	7095	9254	8376	9482	8047	8990	8691	9678
5.	Primary metals	105372	114428	122780	186099	87044	106810	76136	92207	88067	108056
6.	Fabricated metals	15463	16963	17638	23900	23673	27563	22686	26064	24191	27978
7.	Machinery exc. electrical	23872	25959	27780	41554	43462	52185	41153	49028	43595	52606
8.	Electrical manufactures	14534	15940	16734	22937	14788	17315	14416	16644	14878	17449
9.	Other manufacturing	47698	55244	57364	82274	95033	114598	91258	108317	95316	115819
0.	Railroad transportation	58899	64127	67622	94939	82181	96834	79529	92928	82406	97320
1.	Trucking & warehousing	5702	64127	6727	9440	8112	9718	7695	9054	8172	9830
2.	Other transportation	85948	6466	104561	170071	246585	308437	231442	287785	246746	309484
3.	Communication	28438	96672	35533	53483	44815	55570	42466	51573	45007	56300
4.	Electric utilities	81169	34047	98963	156984	183110	228373	176036	217996	183306	229517
5.	Gas utilities	13356	92285	16414	25196	13763	17475	11994	15015	13792	17512
6.	Other utilities	7463	15509	9212	13490	13604	16536	13074	15602	13641	16720
7.	Wholesale trade	64769	76886	79973	118319	93638	115193	88311	106507	94247	116837
8.	Retail trade	117326	146606	151220	228065	227679	285061	215508	263126	228914	289936
9.	Finance, ins., real estate	178131	220397	230352	367393	259872	331431	236035	295594	260882	336128
0.	Hotels, pers. & repair serv.	36988	49785	51541	92564	62167	84322	57809	78041	62496	85816
1.	Business services	18438	21153	22317	33921	28295	34935	25624	31120	28482	35299
2.	Medical, educational	93764	122680	127047	215002	150684	198722	141244	184238	151403	202088
3.	Other services	33056	36575	37572	48027	42507	48314	41376	46588	42597	48633
4.	Federal govt. enterprise	12882	15321	16072	24756	22339	27868	21116	25946	22411	28177
5.	State & local govt. ent.	14699	16977	17997	27760	31329	38826	29847	36593	31381	39086
	Total	2453402	2803905	2970255	4580297	3868314	4803895	3480371	4258789	3891548	4858181

for the construction industry is increased again to account for increased construction activity in the taconite industry which is supported by external financing sources. Thus, for the 1974-85 period, the projected market share is increased from .00085 percent to .00018 percent of the construction industry output in the U.S. An additional net employment increase of 740 is projected (from the Baseline I level of 335 to the 1985 Baseline II level of 1075) as a result of the counter-balancing market and productivity changes.

Growth projection series

Two projection series are presented which illustrate the use of the SIMLAB projections in regional economic impact studies. One projection series -- Growth A -- shows the total regional interindustry, direct and indirect effects of a given reduction in the gross output of the iron mining industry (such as Reserve Mining). Another projection series -- Growth B -- shows the total interindustry effects stemming from the introduction of a copper-nickel industry in the region (for example, in the Ely area). The Growth B projections imply an initial period of construction before any new industry output is feasible. Full production levels are reached several years later.

Neither currently available data nor analytical technique are adequate for dealing with the total social and economic consequences of a specific facility shutdown, even though the gross output effects are readily measurable. A given output reduction in the iron mining industry, for example, is attained in several ways; by a uniform percentage cutback among all producers; by selective and disproportionate cutbacks among all producers;

or, by complete shutdown of a single facility. The immediate local effects will differ in each case. In the current study, neither the local economic nor the more widespread social and political consequences of complete facility shutdown are demonstrated.

A time schedule is postulated for the initiation of growth alternative. The Growth A alternative starts with a cutback of 11 percentage points in regional market share in 1980 which is equivalent to a 22.5-million ton reduction in projected industry output. The accumulative effects of the given output results in a 12,025 reduction in total projected employment in 1985. The Growth B alternative starts with facility construction in 1978 and industry output in 1980. The accumulative impact of the Growth B option results in a 1,279 increase in total projected employment by 1985.

Simulating Alternative Futures

A series of computer simulation exercises have been completed, given the baseline and growth assumptions cited earlier. At this time the computer simulation is confined to a short version of the University of Minnesota Regional Development Simulation Program, namely, SIMLAB I. This program makes use of a series of nine core modules -- market, investment, demand, production (input-output), employment, value added, labor force, population and household (10). Two new modules are being added now -- fiscal and ecologic. A series of government function models -- energy, pollution control, employment services -- will be added later.

The alternative sets of assumptions in the baseline and growth projections yield vastly different results in the year-to-year variability of the principal economic and demographic indicators. The significance of economy is examined in terms of the selected indicator series.

Gross output and employment

In both the baseline and the growth projection series, total industry output is substantially larger in 1985 than 1974. For some industries, output is projected to double or nearly double; e.g., iron mining, construction, and services.

Employment shows markedly different patterns of change than output. In the Baseline I projection series, total employment grows by 12.4 percent -- from 125,279 in 1970 to 142,365 in 1985. Employment in several industries is projected to decline, for example, agriculture, construction and transportation.

In Baseline II projection, the total employment change is 40 percent greater than the Baseline I projection -- 21,762 as compared with 15,538. Agriculture employment again is projected to decline but substantial increases are projected, not only in mining and construction, but also in the service industries. Growth in the economic base thus triggers a "ripple" effect which is felt subsequently throughout the regional economy and, especially, in the service industries. The 1970-74 period thus differed markedly from its initially projected employment levels. Expansion of the construction and service industries were provided for the shift

in regional economic activity indicated in the comparison of the two baseline projection series.

The two growth projections show contrasting patterns of regional economic development. A 25 percent cut-back in mining industry output in the Growth A projections is associated with negative economic impact as shown by the projected decline of 12,025 in total employment. Every sector would suffer from the projected decline of the mining industry.

In contrast, the Growth B projections show a significant increase in employment. However, relative to the total economy, the projected employment increase of 1,179 is overshadowed by the large overall employment growth.

Population and expenditures

Expanding industry output and employment has immediate impacts on population, income, and expenditures. New jobs open for those qualified, including persons residing outside the region. By in-migration, the existing population profile of the region is modified. Generally, in-migration results in a younger population and labor force (while out-migration increases the average age).

Total population in the Study Region is projected to increase from 374,772 in 1970 to 406,300 in 1985 in the Baseline I series (Table 10). Under the Baseline II assumptions, the projected population increase is 55,300 (as compared to 31,500 in the Baseline I series). Thus, the improved economic conditions of the 1970-74 period account for the additional 23,800 in projected regional population.

Table 10. Baseline of growth projections of selected economic indicators, Head-of-the-Lake Region, 1970-1980

Year	Population				Personal Consumption Expenditure	Personal Income Per Capita	Labor Force	Employment	Unemployment	
	Births	Deaths	Migration	Total					Total	Rate
	(no.)	(no.)	(no.)	(100)	($100)	($)	(100)	(100)	(100)	(pct.)
Baseline I:										
1975	6417	2358	-6986	3908	9610	3438	1456	1325	11975	8.22
PTC.	4.93	-.38		-1.11	1.24	3.74	-.75	-1.34		
1976	6551	2337	-8021	3852	9855	3600	1440	1318	11097	7.71
PCT.	1.24	-.89		-1.43	2.55	4.71	-1.10	-.53		
1977	6548	2297	-6775	3812	10244	3776	1427	1320	9633	6.75
PCT.	-.05	-1.71		- .04	3.95	4.89	-.90	.15		
1978	6470	2271	-4590	3798	10743	3951	1420	1328	8008	5.64
PCT.	-1.19	-1.13		-.37	4.87	4.63	-.49	.61		
1979	6552	2247	-2120	3815	11321	4108	1418	1341	6626	4.67
PCT.	1.27	-1.06		.45	5.38	3.97	-.14	.98		
1980	6758	22 7	-709	3852	11915	4249	1421	1353	6133	4.32
PCT.	3.14	-1.34		.97	5.25	3.43	.21	.89		
1981	6876	2211	710	3907	12524	4373	1430	1364	6880	4.81
PCT.	1.75	-.27		1.43	5.11	2.92	.63	.81		
1982	6926	2172	-715	3946	13040	4501	1433	1369	7065	4.93
PCT.	.73	-1.76		1.00	4.12	2.93	.21	.37		
1983	6823	2148	-716	3984	13579	4637	1435	1373	6857	4.78
PCT.	-1.49	-1.10		.96	4.13	3.02	.14	.29		
1984	6637	2130	-717	4020	14142	4780	1435	1379	6652	4.63
PCT.	-2.73	-.84		.90	4.15	3.08	0	.44		
1985	6426	2120	-17	4063	14763	4925	1438	1386	6277	4.36
PCT.	-3.18	-.47		1.07	4.39	3.03	.21	.51		
Baseline II:										
1975	6118	2317	12861	4048	10485	3737	1505	1469	4681	3.11
PCT.	11.42	2.61		5.06	6.72	-.19	5.47	1.45		
1976	6794	2389	5153	4155	10763	3757	1550	1460	10046	6.48
PCT.	11.05	3.11		2.64	2.65	.54	2.99	-.61		
1977	7320	2415	-916	4193	10922	3825	1567	1443	11270	7.19
PCT.	7.74	1.09		.91	1.48	1.81	1.10	-1.16		
1978	7543	2419	-6120	4169	11069	3952	1561	1426	12395	7.94
PCT.	3.05	.17		-.57	1.35	3.32	-.38	-1.18		
1979	7529	2392	-7913	4124	11338	4124	1546	1417	11767	7.61
PCT.	-.19	-1.12		-1.08	2.43	4.35	-.96	-.63		
1980	7368	2344	-7043	4088	11764	4319	1529	1419	9865	6.45
PCT.	-2.14	-2.01		-.87	3.76	4.73	-1.10	.14		
1981	7298	2315	-4211	4087	12347	4506	1519	1430	7806	5.14
PCT.	-.95	-1.24		-.02	4.96	4.33	-.65	.78		
1982	7443	2256	-1081	4125	13036	4668	1521	1446	6348	4.17
PCT.	1.99	-2.55		.93	5.58	3.60	.13	1.12		
1983	7557	2233	760	4188	13733	4806	1527	1461	6750	4.42
PCT.	1.53	-1.02		1.53	5.35	2.96	.39	1.04		
1984	7581	2223	763	4251	14371	4934	1532	1470	7230	4.72
PCT.	.32	-.45		1.50	4.65	2.66	.33	.62		
1985	7507	2222	-190	4301	14954	5071	1533	1475	6838	4.46
PCT.	-.98	-.04		1.18	4.06	2.78	.07	.34		

Table 10. Baseline of growth projection of selected economic indicators, Head-of-the-Lake Region, 1970-1980 (continued)

Year	Population				Personal Consumption Expenditure	Personal Income Per Capita	Labor Force	Employment	Unemployment	
	Births	Deaths	Migration	Total					Total	Rate
	(no.)	(no.)	(no.)	(100)	($100)	($)	(100)	(100)	(100)	(pct.)
Growth 'A':										
1975	6118	2317	12861	4048	10485	3737	1505	1469	4681	3.11
PCT.	11.42	2.61		5.06	6.72	-.19	5.47	1.45		
1976	6794	2389	5153	4155	10763	3757	1550	1460	10046	6.48
PCT.	11.05	3.11		2.64	2.65	.54	2.99	-.61		
1977	7320	2415	-916	4193	10922	3825	1567	1443	11270	7.19
PCT.	7.74	1.09		.91	1.48	1.81	1.10	-1.16		
1978	7543	2419	-6120	4169	11069	3952	1561	1426	12395	7.94
PCT.	3.05	.17		-.57	1.35	3.32	-.38	-1.18		
1979	7529	2392	-7913	4124	11338	3892	1546	1365	16938	10.95
PCT.	-.19	-1.12		-1.08	2.43	-1.49	-.96	-4.28		
1980	7368	2344	-10995	4040	11107	4020	1510	1323	17640	11.67
PCT.	-2.14	-2.01		-2.04	-2.04	3.26	-2.33	-3.08		
1981	7187	2295	-10619	3959	11269	4215	1471	1308	15154	10.30
PCT.	-2.46	-2.09		-2.00	1.46	4.85	-2.58	-1.13		
1982	7137	2205	-10451	3881	11625	4450	1427	1306	11016	7.72
PCT.	-.70	-3.92		-1.97	3.16	5.58	-2.99	-.15		
1983	6948	2135	-6742	3847	12213	4681	1394	1316	6706	4.81
PCT.	-2.65	-3.17		-.88	5.06	5.19	-2.31	.77		
1984	6704	2085	-697	3885	13012	4864	1387	1338	4150	2.99
PCT.	-3.51	-2.34		.99	6.54	3.91				
1985	6530	2072	2011	3954	13786	5004	1391	1355	4716	3.39
PCT.	-2.60	-.62		1.78	5.95	2.88	.29	1.27		
Growth 'B':										
1975	6118	2317	12861	4048	10485	3737	1505	1469	4681	3.11
PCT.	11.42	2.61		5.06	6.72	-.19	5.47	1.45		
1976	6794	2389	5153	4155	10763	3757	1550	1460	10046	6.48
PCT.	11.05	3.11		2.64	2.65	.54	2.99	-.61		
1977	7320	2415	-916	4193	10922	3825	1567	1443	11270	7.19
PCT.	7.74	1.09		.91	1.48	1.81	1.10	-1.16		
1978	7543	2419	-6120	4169	11069	3952	1561	1426	12395	7.94
PCT.	3.05	.17		-.57	1.35	3.32	-.38	-1.18		
1979	7529	2392	-7913	4124	11338	4137	1546	1419	11540	7.46
PCT.	-.19	-1.12		-1.08	2.43	4.68	-.96	-.49		
1980	7368	2344	-6691	4092	11814	4349	1530	1427	9230	6.03
PCT.	-2.14	-1.12		-.78	4.20	5.12	-1.03	.56		
1981	7308	2316	-3214	4103	12487	4546	1526	1448	6691	4.38
PCT.	-.81	-1.19		.27	5.70	4.53	-.26	1.47		
1982	7482	2262	763	4165	13278	4696	1536	1470	6408	4.17
PCT.	2.38	-2.33		1.51	6.33	3.30	.66	1.52		
1983	7653	2249	779	4228	13947	4824	1542	1482	7185	4.66
PCT.	2.29	-.57		1.51	5.04	2.73	.39	.82		
1984	7689	2239	47	4283	14536	4952	1545	1487	6905	4.47
PCT.	.47	-.44		1.30	4.22	2.65	.19	.34		
1985	7601	2236	2045	4362	15215	5067	1557	1497	7127	4.58
PCT.	-1.14	-.13		1.84	4.67	2.32	.78	.67		

The growth projection series again show contrasting patterns of population change. The Growth A projections show the least population change -- only 20,600. This compares with a population change of 61,400 in the Growth B projection series.

Associated with the expandedlevels of industry and population activity are a host of related events and indicators -- births, deaths, migration, personal consumption expenditures, personal income per capita 6/, and unemployment. For the Study Region, the high level of construction activity is a major factor in accounting for the reduced levels of unemployment. By the same token, short-term cutbacks in construction add immediately to unemployment levels.

Energy requirements

The regional economic data base and computer simulatiom model are used, finally, in deriving estimates and projections of industry energy requirements (Table 11). Only intermediate (not final) demand requirements are specified.

The Baseline I and Baseline II projection series show slightly different growth patterns in energy requirements because of the accumulative impacts of the unanticipated (in 1970) changes in the Study Region economy which occurred in the 1970-75 period to which the Baseline II projection series is calibrated. The projected expansion in total energy requirements

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6/ Personal income and personal consumption are shown in constant 1970 dollars.

Table 11. Specified Energy requirements of all industry, by type of projection, Northeast Minnesota and Douglas County, Wisconsin, 1970-1985.

Item	Units	Estimated 1970	Baseline Projection			Growth Projection, 1985	
			1974(I)	1985			
				I	II	A	B
Coal	1000 tons	2007	2459	4072	5196	4652	5208
Natural gas	B. C. F.	57	70	119	129	107	130
Fuel oil distillate	M Gallons	83	101	162	206	187	207
Fuel oil residual	M Gallons	27	32	48	43	40	43
Electricity	M KWHRS	2946	3623	6179	6269	5047	6292
Coal	Billion B.T.U.	42616	52195	86446	110318	98764	110565
Natural gas	Billion B.T.U.	57231	70124	119336	129386	106965	129567
Fuel oil distillate	Billion B.T.U.	11460	14066	22504	28570	25991	286666
Fuel oil residual	Billion B.T.U.	4090	4800	7212	6418	5940	6451
Electricity	Billion B.T.U	10051	12362	21081	21390	17220	21468

shown in the high-level projection series points to the critical importance of energy supplies to the resource-based industries.

Future curtailment of natural gas and petroleum supplies would reduce industry output substantially below projected 1985 levels. However, specific industry impacts would depend on the energy allocation plans in effect at the time of the energy shortages. Application of alternative energy allocation criteria, e.g., minimum unemployment vs. maximum gross production, would result, of course, in widely different impacts.

Literature Cited

1. Chervany, Norman L., J. David Naumann and Roland D. Visness, REIS: Phase II, Report I: An Overview of the REIS System. Regional Energy Information Systems and Economic Impact Analysis Project, Sponsored by Minnesota Energy Agency, Management Information Systems Research Center, College of Business Administration, University of Minnesota, and Agricultural Experiment Station, Institute of Agriculture, University of Minnesota, July 1975.

2. Gronseth, Glenn O., and Cecil H. Meyers, "A Graphic Summary 1952-1967", Duluth Business Indicators, University of Minnesota, Duluth, MN 55812, 1968.

3. Hughes, J. M., "Forestry in Itasca County's Economy: An Input-Output Analysis," Misc. Report 95, Forestry Series 4, Agricultural Experiment Station, University of Minnesota, St. Paul, MN 55108, 1970.

4. Hwang, Henry H. and Wilbur R. Maki, A Guide to the Minnesota Input-Output Model, Research Bulletin (in process), Department of Agricultural and Applied Economics and Agricultural Experiment Station, University of Minnesota, St. Paul, MN, 1976.

5. Jesswein, W. A. and R. W. Lichty, The Employment Impact of Reserve Mining Company on the Arrowhead Region of Northeast Minnesota plus Douglas County, Wisconsin, Report No. 1, Econ. Development Admin. Arrowhead Reg. Dev. Commission, Lake Superior Basin Studies Center-University of Minnesota, Duluth, MN, July, 1974.

6. Lichty, R. and W. Jesswein, An Interim Report on the Economic Base of the Duluth-Superior Growth Center, A joint effort of the Arrowhead Regional Development Commission and Northwestern Wisconsin Regional Planning and Development Commission funded by the Upper Great Lakes Regional Commission, August, 1973.

7. Maki, W. R., R. A. Barrett and R. J. Brady, "Use of Simulation in Planning," Staff Paper P75-17, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, MN, 1975.

8. Maki, Wilbur R., et. al., Economic Data Base for Long-Range Energy Planning in Northeast Minnesota and Douglas County, Wisconsin, Regional Economic Impact Analysis Project, Sponsored by Minnesota Energy Agency, Management Information Systems Research Center, College of Business Administration, University of Minnesota, and Agricultural Experiment Station, Institute of Agriculture, University of Minnesota, August, 1975.

9. Maki, Wilbur R. and Jawaid U. Elahi, "Environmental-Economic Impact of Canadian Crude Oil Curtailment on Minnesota," Staff Paper P76-8, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, MN, Feburary 24, 1976.

10. Maki, Wilbur R., R.E. Turnquist, and E.C. Venegas, "Minnesota Energy-Economic Information System" Staff Paper P76-15, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, MN, April 1976.

11. Meyers, Cecil H., "A Six County Study, Indexes of Business Activity in Northeastern Minnesota 1951-1966, Bureau of Business and Economic Research, University of Minnesota, Duluth, MN 55812, 1968.

12. Orning, George W. and Les Maki, Land Management Information in Northwest Minnesota: the Beginning of a Statewide System, Report No. 1, Minnesota Land Management Information System (MLMIS), University of Minnesota Center for Urban and Regional Affairs, Minneapolis, 1972.

13. Rusch, Pamela G., John R. Borchert, and George W. Orning, Land for Development Adjoining Northern Minnestoa's National Recreational Corridor, Report No. 2, Minnesota Land Management Information Systems Study, Minneapolis: University of Minnesota, Center for Urban and Regional Affairs, Prepared for the Minnesota State Planning Agency and the Upper Great Lakes Regional Commission, December 1972.

14. Stam, Jerome M., "An Economic Analysis of the Lake of the Woods-Rainy Lake Region of Minnesota," Agri. Exp. Station, in cooperation with Economic Development Division, Economic Research Service, U.S. Department of Agriculture, Misc. Report 115, 1972.