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## **Staff Papers Series**

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### SIMULATING ALTERNATIVE GROWTH POLICY

#### SCENARIOS FOR A METROPOLITAN REGION

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🥢 Wilbur R. Maki



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## SIMULATING ALTERNATIVE GROWTH POLICY SCENARIOS FOR A METROPOLITAN REGION $\frac{1}{}$

#### Wilbur R. Maki

Much of urban growth policy in the United States today is capsuled in the idea that "most growth should occur in areas already provided with urban services".  $\frac{2}{}$  In the Twin Cities Metropolitan Area (TCMA) -- a seven-county planning and development district focusing on the two inner cities of Minneapolis and St. Paul (fig. 1), the stated policy of its Metropolitan Council confines future urban development to (1) the two-inner cities, (2) the inner ring, (3) the developing ring, and (4) the freestanding growth centers in the outlying rural area. Urban development is "staged" in this "urban service area". It is precluded in the outlying "rural service area". Public facility cost savings of the "guided" growth policy are projected in excess of \$2 billion by 1990 as a result of confining the new housing to 200 square miles rather than the 1,000 square miles required under a "continuing trends" option.  $\frac{3}{}$ 

 $\frac{1}{2}$  Contributions of collegues Mason Chen, Bud Crewdson, L. A. Laulainen, Jr., D. R. Newell and Mike Stutzer in the implementation of the metropolitan area simulation model are gratefully acknowledged. I appreciate particularly their interest and assistance in building SIMLAB II and related computer simulation programs for producing the alternative policy scenarios cited in this report.

2/ Metropolitan Council of the Twin Cities' Metropolitan Area, "Metropolitan Investment Framework," In: <u>Metropolitan Development</u> Guide, October 9, 1975.

3/ The 1990 projections, although based on an intermediate level of population growth rather than the currently accepted low projection, indicates the direction and magnitude of perceived cost savings from a staged development policy. See: Metropolitan Council of the Twin Cities' Area "Development Framework Policy, Plan, Program," In: Metropolitan Development Guide, September 1975.





## Figure 1. Physical planning units of the Metropolitan Council, Twin Cities Metropolitan Area, Minnesota, 1976.

 $\mathbf{2}$ 

A policy focus on "guided" rather than "optimal" growth is proposed as a practical urban management alternative in holding down per capita costs in the provision of essential municipal services.  $\frac{4}{}$  Choice of an "optimal" rate of growth implies wide citizen (consumer) participation in the negotiation of certain trade-offs to achieve some sort of working agreement for collective action.  $\frac{5}{}$  Under either alternative, the control of urban growth is difficult, if not impossible, to achieve within a single urban region. Also, widespread recognition and understanding of the urban growth process, its total impact on a metropolitan region, and its potential for redirection by state and local governments, is lacking. This paper is a contribution in bridging the gap between growth policy and economic analysis with emphasis on data and information needs for state and regional planning.

#### Metropolitan Growth Policy Process

Concerted efforts in developing a metropolitan growth policy start with the preparation and use of metropolitan population projections. In 1970,

<sup>4/</sup> Robert H. Frelich and John W. Ragsdale, Jr., "Legal Study of the Control of Urban Sprawl in the Minneapolis-St. Paul Metropolitan Region," Metropolitan Council of the Twin Cities' Area, January, 1974. Robert C. Einsweiler, et al, "Comparative Descriptions of Selected Municipal Growth Guidance Systems," preliminary report prepared under Grant No. G139070 for the National Science Foundation, School of Public Affairs, 909 Social Science Building, University of Minnesota, Minneapolis, MN, 55455, 1975.

<sup>&</sup>lt;sup>5/</sup> George C. Lodge, <u>The New American Ideology</u>, Alfred A. Knopf, New York, 1975, and, Robert Theobold, <u>Beyond Despair</u>: <u>Directions for</u> <u>America's Third Century</u>, The New Republic Book Co., Inc., Washington, DC, 1975.

when the most widely-publicized U.S. population projection for the year 2000 was in excess of 300 million, the corresponding Metropolitan Council's population projection for the TCMA was in excess of 3 million -- a projected increase of 1.3 million in 30 years. This figure was reduced subsequently to 2, 888,000, which is the figure still used by the Metropolitan Council, and it was reduced further to 2, 356,000, which is the figure used currently by the State Planning Agency in statewide planning (table 1). In the past five years, therefore, area population growth expectations were reduced by nearly two-thirds -- a reduction attributed to recent changes in population growth and its spatial distribution within the State as well as the Nation.

The changing population perspectives, and the growing concerns about jobs as well an environment, require some extension of metropolitan growth objectives and policies. "Maintaining high quality of life", "accomodating projected growth rationally and economically", and "guiding metropolitan growth and development decisions" to reduce the per capita costs of public facility and service delivery remain the general goals of metropolitan area planning. Concerns about the costs of doing business and the prerequisites for self-sustaining economic growth of a particular character and quality, however, are the added dimensions of an emerging metropolitan regional growth policy. Describing and delineating an "optimal" rate of growth for the metropolitan area is viewed as part of this emerging policy process. The choice of an "optimal" rate will vary among the many decision-making groups of a metropolitan region.

Table l.	Estimated	and	projected	population	and	employment,	U.S.,	Minnesota	and	Twin	Cities	Metropolitan	Area,	1970-2000.
----------	-----------	-----	-----------	------------	-----	-------------	-------	-----------	-----	------	--------	--------------	-------	------------

				Po	pulation	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		and the second			Emplo	ployment			
			Estima	ted		Pr	ojected		Labor f	orce (per	sons)	Work fo	orce (job	s)	
	Series	<u>Total</u> July 1, 1970	<u>Change, 19</u> Natural Increase	<u>70-1974</u> Migra- tion	<u>Total</u> July 1, 1974	<u>Change, 19</u> Natural Increase	074-2000 Migra- tion	<u>Total</u> July 1, 2000	Estim July 1, 1970	ated July 1, 1974	Pro- jected 2000	<u>Estima</u> 1970	1974	Pro- jected 2000	
n maarin (heessaad Robertsinger, die gebeurse kennigen aante	- 4		an a			(1,000)			en an			and a second			
United States	11 11	204,875	5,617	5,619	211,909	40,185	10,400	262,494	79,705	88,164	117,891	86,922	94,091	127,191	
Minnesota	<u>3</u> /- Base	3,810	101	6	3,917	653	83	4,153	1,476	1,603	2,154	1,618	1,809	2,389	
TCMA	<u>3</u> / Base	1,875	64	-35	1,904	409	23	2,336	796	842	1,151	887	972	1,306	
	Low	1,875	64	-35	1,904	409	-177	2,136	796	842	1,052	887	973	1,146	
	High	1,875	64	-35	1,904	. 409	233	2,536	796	842	1,250	887	973	1,444	

1/ Average annual level, compiled from U.S. Department of Commerce, Regional Economic Information System, November 1975.

2/ U.S. Bureau of the Census, <u>Current Population Reports</u>, Series P-25, No. 60, "Projections of the Population of the United States: 1975 to 2050," U.S. Government Printing Office, Washington, D.C., 1975.

3/ Population Estimates for Minnesota Counties, 1974, July 1975; Minnesota Population Projections: 1970-2000, November 1975; and Minnesota Labor Force Projections, July 1976, State Planning Agency, Division of Development Planning, 101 Capital Square Building, St. Paul, Minnesota, 55101, November 1975.

4/ Two growth options are derived from a 200,000-person range in projected migration level. Employed work force is linked to employed labor force and migration levels, with out-migration implying a lower work force-to-labor force ratio and in-migration implying a disproportionately higher ratio. The TCMA experience cited here illustrates the expanding policy concerns of metropolitan agencies which face rapidly rising public costs of urban development in the midst of increasing local economic uncertainties. To facilitate examination of these concerns, a community development simulation laboratory is being implemented at the University of Minnesota to provide decision makers, among others, with a regional economic forecasting system for assessing the state and local impacts of anticipated or proposed market and policy changes. While this system is being used in numerous studies in the State, its use in the TCMA has awaited until now for completion of the Metropolitan Council's Input-Output Study.  $\frac{6}{}$ 

The Simulation Laboratory makes use of a computer/user interactive program that is accessed on the Minnesota Educational Regional Interactive Time Sharing System (MERITSS). This program provides for a modular approach to regional economic modeling and information systems development. A set of eleven modules -- market, investment, demand, production (i. e., interindustry transactions), employment, value added, labor force, population, household, fiscal and ecologic -- provides the data base and programming routines for simulating a regional economy. An additional set of government function modules is being prepared, including energy and environmental management, to provide an auxiliary data base and forecasts for state and local government agencies. The series of data

<sup>6/</sup> Metropolitan Council of the Twin Cities Area, "The Structure of the Twin Cities' Economy: An Input-Output Perspective," March 1976.

modules and related computer programs is organized as a readily accessible regional economic impact forecasting and simulation system.  $\frac{7}{}$ 

Both short-term and long-term regional economic impact forecasts are being prepared in the Simulation Laboratory (SIMLAB). Alternative national market and policy projections and assumptions are introduced into the market and institutional modules to provide alternative bases for regional investment and Siscal demand forecasts. The production, employment and related input-output type modules enter into the computational procedures for simulating specific industry, as well as economy wide, impacts of the externally-induced changes. For example, the extended local impacts of an urban renewal project to expand the local economic base can be derived for both the construction period and the subsequent production periods. A series of market-share levels are postulated, along with related employment and capital requirements. Finally, direct and indirect effects of the projected business activity are derived and presented in a series of tabular (and graphic) displays.  $\frac{8}{}$ 

8/ W. R. Maki, L. A. Laulainen, Jr., and M. C. Chen, "User Guide to SIMLAB II," Economic Report (in process), Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota, February 1977.

<sup>&</sup>lt;sup>7</sup>/ W.R. Maki, R. E. Turnquist and E. C. Venegas, "Minnesota Energy-Economic Information System," Dept. of Agricultural and Applied Economics, Staff Paper P76-15, University of Minnesota, St. Paul, Minnesota, April 1976.

#### Metropolitan Growth Alternatives

The preparation of alternative metropolitan growth scenarios depends on some sort of strategy in deriving a useful set of explicit and verifiable market and policy assumptions about the principal determining factors in regional economic growth. From a regional planning perspective, the forecasting of regional population and its distribution is a central task and the first completed in both state-level and substate planning efforts. In Minnesota, the determination of the future distribution of population is approached initially in a demographic framework. The critical question is the rate of migration, by age and sex class, for a given forecast period. The underlying assumptions are extended to area-specific migration, as well as birth and death, rates.

#### Population

Alternative population projections for the TCMA are cited for their illustrative value in testing and presenting some metropolitan growth alternatives. As recently as January 1973, the Upper Midwest Council projected a 37 percent increase in total population of the five-county Minneapolis - St. Paul SMSA, which compares with a projected total population increase for the State of 12 percent from 1970 to 1980 and 19 percent from 1970 to 1985 (i.e., from 3,805,000 in 1970 to 4,251,000 in 1980 and 4,522,000 in 1985).  $\frac{9}{}$ 

<sup>9/</sup> Neil C. Gustafson, <u>Recent Trends/Future Prospects: A Look at</u> <u>Upper Midwest Population Changes</u>, Upper Midwest Council, Federal Reserve Bank Building, Minneapolis, Minnesota, January 1973. Also, see: Neil C. Gustafson and Mark E. Cohan, <u>Population Mobility and the</u> <u>Upper Midwest: Trends</u>, <u>Prospects</u>, and <u>Policies</u>, <u>Upper Midwest Council</u>, Federal Reserve Bank Building, Minneapolis, MN, July 1974. The fivecounty area cited in these two reports accounted for 96.7 percent of the total TCMA population in 1970, but this percentage is declining as urban development expands in the 'developing'' ring and the ''free-standing growth centers''.

Three years earlier, Borchert and Carroll derived a series of projected population increases for the 1970–85 period ranging from 14 percent to 43 percent for the seven-county metropolitan area and from 13.5 to 23 percent for the State.  $\frac{10}{10}$  A majority of the projections, and, expecially the metro area projections, substantially exceed the currently used series. These projections were linked to five different sets of assumptions which were described as follows: (1) continuation of 1940-70 trends; (2) defense expenditure replacement without geographic realignment; (3) "heartland" policy without continued regional centralization: (4) "heartland" policy with dispersal; and (5) absent or ineffective "heartland" policy with continued regional centralization. None of the assumptions are verifiable in the form given. Indeed, the obvious quantitative relationships between these assumptions and population growth were neither presented nor postulated. The use of scenarios, in this case, was confined to a literary and graphic (i.e., mapping) exercise, which is much less than needed now in metropolitan growth policy design and implementation.

An alternative strategy for population projection is indicated by the "general utilization" projection series prepared in the Office of State Demographer in the Minnesota State Planning Agency from a set of assumptions which are both explicit and, to some degree, verifiable (see,table 1). A baseline projection series is derived from age-sex specific migration

 $<sup>\</sup>frac{10}{}$  John R. Bochert and Donald D. Carroll, Minnesota Settlement and Land Use 1985, Minnesota State Planning Agency, 1972.

trends (which yield a slight in-migration but, nonetheless, a total population which is a declining proportion of the total U.S. population). A corresponding projection series for the Metropolitan Area is derived, also. A summary of assumptions and computational procedures is provided in appendices which accompany the published series. The published data are inadequate, however, to test and verify all of the stated assumptions.  $\frac{11}{}$ 

#### Employment

Employment in a metropolitan region is enumerated by place of residence (i.e., persons in employed labor force) and place of work (i.e., jobs). A high labor force participation rate accounts for the location of a higher percentage of the employed labor force than population in the Metropolitan Area. Further concentration of employment, as measured by jobs, is linked to in-commuting and, probably, an above-average rate of multiple job-holding among employed persons in the Metropolitan Area.

The ratio of jobs to employed persons residing in the Metropolitan Area fluctuates from year to year. An expansion in employment is accompanied by an increase in commuting which, ultimately, leads to in-migration of the employed person and household. In a restricted metropolitan area housing market, as occured in 1974, however, the ratio of jobs to employed persons increases disproportionately with an increase in jobs.

<u>11/</u><u>Minnesota Population Projections: 1970-2000</u>, Division of Development Planning, State Planning Agency, 101 Capital Square Building, St. Paul, MN 55101, November 1975.

In-migration may decline while out-migration of certain age and socioeconomic groups continues from the central cities. Thus, the metropolitan commuting area may expand both geographically and in total number of commuters as the total number of jobs increases.

Finally, the geographical distribution of jobs within the Metropolitan Area follows the new plant construction which is dominantly in the develioing ring of the Metropolitan Area.  $\frac{12}{}$  Plant relocation occurs from the central cities to lower cost and more spacious sites in the suburbs and, also, to a growing pool of blue-collar workers in nearby communities.

#### Commuting

Out-commuting to the "developing ring" is increasing. In the TCMA the expansion of trade and service businesses in the large, diversified shopping centers of the "developing ring" has attracted a flow of commuters -workers and shoppers -- which now surpasses the daily flow into the "central cities".

Only a part of the total commuting in a metropolitan region is revealed in the U.S. Census of Population data (table 2). Commuting to second and third jobs is not shown, nor is the two-stage job replacement process documented.  $\frac{13}{}$  Employed persons commuting from the extended rural

<u>12</u><sup>/</sup> Metropolitan Council of the Twin Cities Area, "Industrial Construction Data for the Twin Cities Metropolitan Area," <u>Data-Log</u>, Economic Report No. 7, May 1976. Also, see: Minnesota Department of Economic Development, Minnesota New and Expanding Industry, 1975.

13/ My colleague, Ron Dorf, has helped document the two-stage job displacement process in his study of rural development in West Minnesota (R. J. Dorf, "Home-to-Work Commuting Patterns in Region 6-E," Unpublished paper, March 1975. LEGISLATIVE REFERENCE LIBRARY STATE OF MINNESOTA

	Place of Employment									
	Inner	Cities	-	Firs	Secor					
Place of residence	Minnea- polis	St.Paul	Rest of Henne- pin	Rest of Ramsev	Anoka	Dakota	Washing- ton	Scott	Carver	Tota
Twin Cities Metro Area: Hennepin Ramsey Anoka Dakota Washington Scott Carver	27.8 2.8 2.5 0.9 0.2 0.1 0.1	2.6 15.1 0.6 1.8 1.3 <u>a/</u> <u>a</u> /	18.7 1.2 0.9 0.8 0.2 0.3 0.4	1.2 4.3 0.8 0.2 0.4 <u>a</u> /	1.0 0.4 2.5 <u>a</u> / <u>a</u> / <u>a</u> / a/	0.5 0.5 0.1 2.8 0.2 0.1 <u>a</u> /	0.1 0.3 0.1 0.2 1.3 <u>a/</u> 0	0.1 <u>a/</u> 0 0.1 0 0.8 0.1	0.1 <u>a</u> / <u>a</u> / <u>a</u> / <u>a</u> / <u>a</u> / 0.7	52.1 24.6 7.4 6.8 3.7 1.4 1.3
Total area	34.4	21.4	22.5	6.9	3.9	4.3	1.9	1,1	0.9	97 <i>.</i> 3
Out-of-Area <sup>b</sup> : North (7E) Northwest (5,7W) West (6E) Southwest (9) Southeast (10) East (Wisc.)	0.2 0.3 <u>a</u> / 0.1 0.2	0.1 0.1 0.1 <u>a/</u> 0.1	0.1 0.3 <u>a/</u> <u>a/</u> 0,2	0.1 _a/ _a/ _a/ _a/ 	0.1 0.1 <u>a/</u> 0 <u>a/</u> <u>a</u> /	<u>a/</u> <u>a/</u> 0 0.1 <u>a</u> /	0 a/ 0 a/ a/	<u>a/</u> 0 0.1 0	0 / / / 0 0	0.6 0.9 0.1 0.2 0.3 0.6
Total, out-of-area	0,8	0.5	0.6	0.2	0,2	0. <u>1</u>	<u>a</u> /	0.1	0.1	2.7
Total, region	35,2	21.9	23.1	7.1	4.1	4,4	2.0	1,2	0,9	100.0

Table 2. Distribution of employed persons of specified place of residence, reported in the 1970 U.S. Census of Population, Twin Cities (Minnesota) Metropolitan Area, April 1, 1970.

a/ Less than 0.05 percent

b) Minnesota substate planning and development districts are shown in parentheses.

area may leave an existing local job for a more renumerative job in the "developing ring". The first job is replaced by a new employee who lives, perhaps, a hundred miles or more from the TCMA. Thus, the available data are of limited value in depicting the level and the direction of the total commuting pattern and its impact on regional growth and development.

#### **Employment Impact Forecasts**

Differentiation of place of work and place of residence in employment impact forecasting is accomplished by the use of two county-level employment series. A U.S. Census of Population data series is available for a 35-sector breakdown (excluding military) of total county-level employment (estimated, 1960-1970 and projected 1980-2000).  $\frac{14}{}$  This series is derived, in part, from existing national data sources.  $\frac{15}{}$  A 39-sector breakdown (including military) of total county-level employment by industry is available, also, for use with related input-output studies in Minnesota.

 $<sup>\</sup>frac{14}{}$  W. R. Maki, D. R. Newell, L. A. Laulainen, Jr., and M. Chen "Minnesota Employment Indicators, by Region: Trends and Projections to Year 2000," REIFS Report No. (in process), Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, MN January 31, 1977.

<sup>15/</sup> U. S. Department of Commerce, Social and Economics Statistics Administration, Bureau of Economic Analysis, <u>Regional Employment by</u> <u>Industry, 1940-1970</u>, U.S. Government Pringing Office, Washington, D.C., 20402, 1975. U.S. Water Resources Council, 1972, OBERS Projections, Regional Economic Activity in the U.S., Series E Population, U.S. Government Printing Office, Washington, D.C., 20402, April 1974. U.S. Department of Commerce, Office of Business Economics, <u>Growth Patterns</u> in Employment in County, 1940-1950 and 1950-1960. U.S. Government Printing Office, Washington, D.C., 20402, 1965.

This series is derived from job-related employment series collected by the U.S. Bureau of Labor Statistics and, in Minnesota, the Department of Employment Services.  $\frac{16}{4}$ 

Two baseline series of employment impact foreeasts are derived from the two employment data series by use of the shift-and-share technique. This technique is used simply because of its widespread availability for the allocation of projected state-level employment change to substate regions. It is not the projection methodology recommended for employment and income forecasting, nor is it used in SIMLAB. Its use is confined to the regionalization (or further county-level disaggregation) of the state-level employment and income forecasts derived from SIMLAB.

A state-level employment series is prepared, first, with the U.S. as the "Nation" and the State as the "Region". A second stage of computations yields the individual planning region baseline employment projections (table 3). In this series, the State is the "Nation". Thus, the state-growth and industry-mix effects are derived from the state-level projections. Only the regional-share effects must be projected for each industry in the TCMA.

<sup>&</sup>lt;u>16</u>/ Minnesota Department of Employment Services, Research and Planning Branch, <u>Minnesota Employment 1970, 1980</u>, St. Paul, Minnesota, 55101, July 1975. U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 1975.

Table 3. Projected change in employed labor force in specified industry, by employmentchange effect, Twin Cities (Minnesota) Metropolitan Area, 1970-1980.

			<u>    Proje</u>	cted Change	d Change, 1970-80				
~	<b>1</b> .	579 - A		Relative	e Change				
ן.י י	dustry	Esti-	State	Industry	Regional		Projecte		
	o. Title	mated	Growth	Mix 2/	Share	Total	. 1980		
60000000000000000000000000000000000000	٢٠٠٠ ﻣﻮﻟﺪﻩ ﺩﻩﺭﻩﻩ ﺩﻩﺭﻩﻩ ﺩﻩﺭﻩﻩ ﺩﻩﺭﻩﻩ ﺩﻩﺭﻩ ﺩﻩﺭﻩ ﺩﻩﺭ	1970	<u>Effect='</u>	<u>Effect<sup>2</sup></u>	<u>Effect</u>	Change	Empl.		
				(nun	mber)				
1.	Agriculture	8430.	1908.	-3941.	-90.	-2123.	6307		
2.	For. and Fish.	150.	34.	-95.	-13.	-73.	77		
3.	Mining	672.	152.	~79.	454.	528,	1500		
4.	Construction	43143.	9764.	-4478.	-843.	4443.	47586		
5.	Food Prod.	20289.	4592.	-3893.	-2755.	-2056.	18533		
6.	Textile Prod.	1225.	. 277 .	-218.	-94.	-34.	<u>]]</u> ]		
7.	Apparel	3775.	854	10.	-507.	357.	4132		
8,	Lumber, Furn,	3750.	849.	~24l•	-293.	315.	4065		
9.	Printing & Pub,	21807·	4935.	-475.	-2705.	1755.	23562		
10.	Chemicals	6594.	1492.	-1099.	~296.	98.	6692		
11.	Machinery, ex. Elec.	49056.	11103.	9457.	-3418.	171410	66197		
12.	Electrical Mach.	15567.	3523.	2670.	-1180.	5014.	20581		
13.	Motor Vehicles	3695.	836.	-1591.	-279.	-1034.	2661		
14.	Transp. Ex. Not. Veh.	4056.	918.	230.	-1025.	122.	4178		
15.	Paper Prod.	15393.	3484.	-289.	12842.	16037.	31430		
16.	Petroleum Refining	1733.	392.	-634.	5,	-237.	1496		
17.	Primary Metal	4130.	937.	153.	312.	1401.	5539		
18.	Fabricated Metals	21178.	4793.	781.	-522.	5052-	26230		
19.	Misc. Manuf.	25116.	5684.	-4186.	22.	1521.	26637		
20	Railroads	11398.	2580.	-4863.	-417.	-2701.	8697		
7	Trucking	13803.	3124.	-217.	-728.	2179.	15982		
22.	Other Transp.	14512.	3284.	976.	-1364.	2893.	17405		
23.	Communications	10467.	2369.	-482.	-315.	1572.	12039		
24	Elec., Gas. Sani.	7901.	1788.	51.	-554.	1285.	9186		
25.	Wholesale Trade	48964	11082.	-1563.	<b>~</b> 1757.	7702.	56726		
26.	Food Stores	20471.	4633.	1000.	-487.	5146.	25617		
27.	Eating & Drinking	28630.	6480.	-1400.	1787.	6867.	35497		
28.	Other Retail	85453	19340	3935.	-8682.	14593	100046		
29	F T R E	48420.	10900.	2277.	~3920.	9317.	57743		
30	Lodging Perconal	20756	4698	-982.	-392.	3325.	24081		
31	Business and Renair	34398	7785	12818.	6859	27462	61860		
32	Entertain & Rec	7247.	1640-	-204	-168	1268.	8515		
33	Private Householde	8036	1819	-5377.	-1256.	-4815.	3521		
34	Prof Services	152219	34451	36108.	-14436.	56122.	208341		
35	Public Admin	21761.	7188.	-1658.	-2742.	2768.	34549		
ه <b>د</b> پ	rubite munitif,	971010	11000	a, √ J ' / U	grag r 7 goog val				
*	Total	7942119.	179750.	32502.	-28961.	183291.	977500		

<u>1</u>/ "State growth effect" refers to the increase in industry employment based on the percentage change in projected total State employment.

2/ "Industry-mix effect" refers to the differential change in industry employment based on the difference between the percentage change in the specified industry employment and total emloyment projected for Minnesota.

<u>3</u>/"Regional-share effect" refers to the differential change in area employment based on the difference between the percentage change in the specified industry employment in the TCMA and the State.

The baseline employed labor force projection series shows a redistribution of total employment in Minnesota away from the TCMA and into out-state regions. The concentration of above-average growth industry in the TCMA accounts for its slightly above-average growth in total employment. Thus, the population-related assumptions, when translated into corresponding employment relationships, imply a shift in historical trends in the geographic location of above-average growth industries in the State. In effect, a redistribution of industry (heretofore concentrating in the TCMA) is indicated by the shift-and-share analysis. This relocation of industry is analyzed in the computer simulations.

The relative change component ( i.e., the sum of "industry mix" and "regional share") in the shift-and-share equation correlates directly with the migration component in the demographic equation. The regional-share coefficient is deployed, also, as a policy-related parameter. It can be projected in the context of certain hypothetical urban policy alternatives in "guiding", not urban development in a given metropolitan area, but total population growth in a multi-area regional settlement system.

The job-based employment series is used primarily to relate the shift-and-share analyses to the SIMLAB computer simulations of alternative area futures. Included among the computer outputs is a table of employment, by industry and occupation, starting with the base year, 1970. The simulated industry employment series are derived from the industry gross output and related output per worker series, which, also, are given in the tabular presentations. Thus, the shift-and-share analyses of jobbased employment are verified from the corresponding SIMLAB outputs.

Given both Minnesota and TCMA computer simulations, the twostage shift-and-share approach is related to the SIMLAB forecast series. Neither the State nor the TCMA analysis are dependent, therefore, on only one analytical approach. Also, given the opprotunity for verification of industry employment assumptions, the two forecasting systems, when used interactively, expand the usefulness of the shift-and-share technique in the formulation of alternative employment growth scenarios.

#### **Product Impact Forecasts**

The Metropolitan Council's Input-Output Study yields both product and employment estimates for a 95-sector breakdown of the TCMA economy in 1971. This study provides the data base for the Production Module in SIMLAB. It also, provides a degree of industry detail for the TCMA heretofore unavailable for the analysis of the rate and direction of economic growth in the Metropolitan Area. The Minnesota two-region input-output system, which is available for those regions lacking an up-todate input-output model, is used in partial verification of the 1971 study findings.  $\frac{17}{}$ 

Preparation and use of area product impact forecasts is illustrated by the 1971 market status of the export-producing industries in the TCMA (table 4). A total of 65 industries is identified with gross exports

 $<sup>\</sup>frac{17}{}$  The two-region model is based totally on secondary data; it includes the corresponding U.S. input-output tables. See, H.H. Hwang and W.R. Maki, "A User's Guide to the Minnesota Two-Region Input-Output Model," Economic Report (in process), Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota, November 1976.

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Table 4. Proportion of total export-related gross output, value added and employment in specified export-producing industry, Twin Cities (Minnesota) Metropolitan Area,1971.

and the second s		· Te	otal Expor	ts	Net	Exports	Not Exports
	- T-alian adverse	Grose	Value	Employ-	Value	Employ-	less other
No	title	Output	added	ment	added	ment	Imports .
<u> </u>				(per	cent)		,
56	Computers and not muchtage	8.345	10.877	7.920	15.469	10.979	20.328
11	New construction	7.330	4.029	4.477	5.950	6.452	3.544
79	Wholesale trade	7.221	. 6.512	8.509	9.612	12.243	7.065
80	Retail trade	5.917	6.774	15.837	12.971	22.822	11.536
13	Ordinance and access.	4.070	5.469	4.380	8.071	6.300	10.891
81	Finance and insurance	4.045	4.823	5.263	2.724	2.898	0
64	Motor vehicle & eq. mfg	4.384	2.418	1.010	. U	· 0	0
74	Motor freight trans. & wareh.	3 754	4.945	5.231	. 1.311	: 7.538	9.591
27	Paper and allied products	3.241	2.601	2.2.540	5.205	2.084	1 726
17	Beverage prod. mfg.	3.178	4,106	1.108	4.110	1.080	3.782
. 33	Drugs, clean. toilet prep.	3.455	1.074	1.210	1.278	1.404	0
- 70	Meat prod. mig.	2.950	1.806	1.753	0	. 0	0
14 70	Other rood products	2.945	3.597	4.087	5.318	5.889	8.332
- 20	Rairroads and ter, serv.	2.784	3.870	2.934	5.302	. 3.918	5.941
84	Buriness services	2.011	2.395	3.126	0	0	0
57	Service industry machines	2.491	3.045	1.927	3.654	2.253	3,954
53	Gen. ind. mach. & equip.	1.053	2.047	.838	1.776	•708	2.061
49	Const. mining. mach. equip.	1.599	1.446	1.577	1.528	1.624	2.221
58	Elect. trans. & distr. eq.	1.490	1.705	1.906		.343	0
75	Air transportation	1.4/5	• 959	1.746	. 193	. 1.408	0 0 044
48	Farm mach. & equip.	1.50	1 260	1.288	20114	. 1.683	2,804
59	Household appliances	1.36	1,194		.535	• 0 4 3	0
78	Elec., gas, water, san. serv.	1.47	1.185	1.468	1.411	1.705	1.913
68	Engin. & scient. instr.	1.051	1.319	1.445	1.038	1,109	1.003
_6/	Prof. instr. & supplies	986	1.098	2.138	.891	1.692	1.058
. 00	Hotels, pers. & repair serv.	• 979	•481	.376	.139	• 106	0
10	Grain mill prod,	.933	. 964	.893	.355	.321	0
6.5	Screw mach. products	.012	.877	1.099	• 316	• 386	0
12	Maint and renair construction	•772	۰859	•215	•381	•093	0
51	Metalworking mach. & equip.	•737	1.083	.937	• 525	443	. 369
36	Rubber & misc. plastics	.711	•835	670	0	0	0
. 35	Petro. ref. & rel. ind.	• 050 • 50	•200	•137	0	0	0
_52	Spec. ind. mach. & equip.	• 559	• / /2		•288	•199	. 262
: 51	Apparei	LB3	• ማማፎ - ሐሐበ	10636	. 572	. 7.26	560
69	Optical, opnin, & photo. equip		-515	- 237		° J Z D N	
- 51	Livestock & live, products	•453	.235	.381	ii i o	0	Ő
	Engines and turbines	.450	.528	.195	.160	• 058	Ő
70	Misc. mfg.	.441	.454	613	0	. 0	0
62	Electronic comp. & access.	.427	.510	• 918	0	0	0
60	Elec. light. & wiring equip.	.413	•459	•641	. 0	0	0
71	Transp. exc.rail, motor air	°<82	.427	•484	. 320	• 353	.356
43	Metal containers	•≤50	190	.123	0	0	0
50	Mat. handling mach. & equip.	0620	•221	•225	·U	0	0
_73	Highway passenger trans.	• < < <	e <b>∠</b> 40	403	U		0
44	Heat, plumb., rab. str. prod.	0617	. 226	.110	0	0	0
32	Other fahr metal arod	-101	.212	0117 232 -	0	0	0
- 40	Painte and allied prod	.151	144	07A		<u>0</u>	. 0
34 34	Paperboard cont. & hove	.138	.101	.153	. 0	õ	0
20 31)	Commercial printing	.135	.159	.142	ŏ	ŏ	ŏ
- 3H	Footwear & other leather prod.	.127	.122	.265	0	0	0
54	Machine shop prod.	.113	.175	•268	0	. 0	' 0
42	Primary nonferrous metals	· 100	.158	096	0	0	0
22	Misc. fab. text. prod.	.100	.107	.161	0	0	0
41	Primary iron & steel mfg.	. 190	.091	.091	0	· 0	0
55	Office & acc. mach.exc.comp.	.070	.125	•076*	•045	•027	.051
- 39	Glass and glass prod.	.063	.045	•031	0	• 0	0
26	Uther furn. & fixtures	• 460	• 065	0.107	0	0	U
_87	mea., educ.serv. nonprofit	• 0 4 4	50Ue	0989	• 010	• 102	. U
37	Learner tanning, ind.leath.pro		0U22	. •030	,U A	0	0 0
61	Amusements	\$010 \$1112	.011	0027 020	· 0	0	0
00		** · * · * 4 4 4 4 10		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	9	1. 0	
	Total	100.000	100.000	100.000	100'. 000	100.000	100.000

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(i.e., sales or shipments to buyers residing outside the area). Of this total, 35 industries show gross exports in excess of gross product imports (as compared with 25 industries in the two-region model), while only 23 industries (as compared with 14 industries in the two-region model) show gross exports in excess of gross industry imports.  $\frac{18}{}$  The industries are ranked according to their gross output value of total exports (see, column 1, table 4). This ranking represents the initial contribution of each industry to the regional economic base.

Alternate indicators of an industry's contribution to the regional economic base are derived from the gross output employment and value added estimates for each industry. In deriving the alternate indicator series, the value added and employment estimates for each industry are allocated, first, between the export-producing and the non-export-producing components. This allocation yields the percentage estimate of the relative contribution of each industry in the area economic base (see, columns 2 and 3, table 4). For example, "computing and related machines" manufacturing accounted for 8.346 percent of total exports. The total export component of its gross output accounted for 10.877 percent of value added and 7.920 percent of employment in the area economic base.

 $<sup>\</sup>frac{18}{}$  The two-region model shows net exports and imports, including wage and salary payments to employed workforce residing outside the TCMA. The Metropolitan Council Input-Output Study allocates all wage and salary payments to a household industry which is not differentiated by place of residence.

High earnings per worker and a large return on capital investment are implied by the higher percentage of value added as compared with employment. Conversely, as in the retail trade sector, a low earnings per worker is associated with a larger percentage estimate for employment than value added.

When gross imports (i. e., the "import" of wholesale and retail trade margins), are deducted from net exports, the two trade sectors are shown as accounting for the largest share of the area economic base (see, columns 4 and 5, table 4). However, the subtraction of other industry imports, which further reduced the net surplus of dollars received on current account from outside the TCMA by the export-producing industries, results in a decline in the relative importance of the trade sector in the area's employment base, (see, column 6). Thus, the contribution of the trade sector to the region's economic base is identified in varying degree in terms of "basic" dollars brought into the area.

The dominant role of trade, transportation and communication services in the economic base of the TCMA is highlighted in the anlaysis of the 1971 interindustry transactions tables. In addition, high technology manufacturing, especially machinery, is identified, also, as an important element in the above-average growth of the area's industrial economy. Thus, both types of industry -- the service and the commodity-producing -- are shown as basic industries which are geographically concentrated in the TCMA. They account for the above-average industry-mix effects cited earlier and they, also, are identified with the negative regional-share coefficients cited earlier.

At this point in the comparison, an apparent conflict exists in the interpretation of the two sets of findings. Unspecified market changes are implicit in the shift-and-share analysis which imply significant changes in projected market-share ratios for the TCMA export-producing industries.

#### Growth Policy Assumptions

The 1971 interindustry transactions tables provide the base year data for (1) depicting the economic structure of the TCMA, and (2) testing alternative growth policy assumptions. Base year and projected data series are produced by SIMLAB. Year-to-year changes associated with alternative growth assumptions -- incorporated in as many as 52 different parameter changes -- are compared and evaluated in terms of their area and state development planning implications (table 5).

Unlike the industry employment series cited earlier, the input-output series identifies employed persons by place-of-work -- both in and out of the TCMA. Local impacts of plant expansion or relocation are introduced into the computational sequence, starting with the new construction (including purchases of specified producer durable equipment) and continuing with the projected operation of output-increasing activities. The detailed employment and plant construction statistics are linked to a series of other economic indicators for assessing and monitoring regional economic growth.

A two-region extension of the TCMA input-output model is used, first, to prepare an interindustry transactions table which includes (1) the new or expanded activity and (2) the corresponding Rest-of-Nation sectors

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Table 5.	List of	parameters	for	user	interactive	simulation	in	SIMLAB	Π.	-

NATIONAL GROWTH RATE REGIONAL MARKET SHARE RATE OF CHANGE IN REGIONAL MARKET SHARE OUTPUT-INCREASING CAPITAL-OUTPUT RATIO POLLUTION ABATEMENT CAPITAL OUTPUT RATIO OUTPUT-INCREASING INVESTMENT, STOCK DEPRECIATION POLLUTION ABATEMENT INVESTMENT, STOCK DEPRECIATION BUSINESS INVENTORY-OUTPUT RATIO INVESTMENT LIMIT COEFFICIENT BUSINESS INVENTORY-OUTPUT CHANGE COEFFICIENT ANNUAL PERCENTAGE CHANGE IN TOTAL CAPITAL-OUTPUT RATIO PERSONAL INCOME FLASTICITY CREFEICTENT 10.01-0 <u>9</u>. 10. 11. PERSONAL INCOME ELASTICITY COEFFICIENT 12. 13. 14. CROSS-PRICE ELASTICITY COEFFICIENT 15. DUTPUT PER WORKER RATIO 16. ANNUAL PERCENTAGE CHANGE IN DUTPUT PER WORKER EARNINGS PER WORKER BY DCCUPATION 17. 18. ANNUAL PERCENTAGE IN PER WORKER EARNING, 19. EMPLOYEE COMPENSATION RATE ANNUAL PERCENTAGE CHANGE IN EMPLOYEE COMPENSATION ŽÒ. INDIRECT TAX RATE ANNUAL PERCENTAGE CHANGE IN INDIFECT TAX RATE CAPITAL DEPRECIATION RATE, DUTPUT-INCREASING 24. CAPITAL DEPRECIATION RATE, POLLUTION ABATEMENT REGIONAL IMPORT RATE LABOR FORCE PARTICIPATION RATE LABOR FORCE PARTICIPATION RATE (MALE) (FEMALE) 28. ANNUAL PERCENTAGE CHANGE IN LABOR FORCE PARTICIPATION RATE (MALE) 29. ANNUAL PERCENTAGE CHANGE IN LABOR FORCE PARICIPATION RATE (FEMALE) 30. POPULATION 1-66+ (MALE) 31. POPULATION 1-66+ (FEMALE) DISTRIBUTION OF MIGRATION RATE BY AGE; 32. MALE WARNING WARNING WARNING WARNING MODIFICATION OF THE FOLLOWING PARAMETERS WILL CHANGE THE DATA BASE 33. DISTRIBUTION OF MIGRATION RATE BY AGE; FEMALE 34. MIGRATION FACTOR FERTILITY RATE...NUMBER OF CHILDREN BORN PER 1000 WOMEN 35. 36. UPPER, MIDDLE, AND LOWER BOUND OF UNEMPLOYMENT RATE 37. EMPLOYMENT BY SPECIFIC INDUSTRY NET CAPITAL STOCK ... DUTPUT PRODUCTION 38. ... DUTPUT CONSTRAINT (FOLLUTION ABATEMENT) 39. NET CAPITAL STOCK GROSS NATIONAL PRODUCT GROSS REGIONAL PRODUCT 40. (CURRENT YEAR) 41. (PREVIDUS YEAR) GROSS REGIONAL PRODUCT 42. REQUIRED OUTPUT OF FINAL DEMAND 43. 44. IN-COMMUTING WORKERS 45. OUT-COMMUTING WORKERS DWN PRICE 46. CROSS PRICE 47. EMPLOYEE COMPENSATION PRIMARY INPUT 48. 49. 50. MIGRATION BY OCCUPATION; WORKERS AND FAMILY 51. UTPUT CONSTRAINT BY CAPITAL STOCKS 52. DUTPUT CONSTRAINT BY LABOR FORCE

 W. R. Maki, L. A. Laulainen, Jr., and M. C. Chen, "User Guide to SIMLAB II," Economic Report (in process), Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota, February 1977. indicated in the U.S. input-output tables. Also, market-share, annual change in market-share and other coefficients (in the series of modules cited earlier) are derived for any new industry brought into the forecasting system. The two-region format allows additional changes in each of the coefficients which are related to particular market and policy assumptions. Thus, a large number of assumptions are specified and, also, evaluated in the series of computer simulations for the TCMA.

A parallel analytical effort is being initiated at the state-level of economic impact forecasting. In this effort, the shift-and-share technique is used to develop alternative substate industry employment profiles for testing the regional employment implications of different industry location criteria. Again, these projections are compared with a corresponding set of SIMLAB employment projections for the State and Metropolitan Area. The two-region input-output model is used in the SIMLAB Production Module for expanding the regional economic impact forecasting and simulation system to other planning and development districts in the State.

A further spatial differentiation of each SIMLAB Module is being initiated as a means of testing the commuting requirements of different industrial and residential location strategies for the TCMA. Results of this effort focus directly on the question of an "optimal" growth strategy for the Metropolitan Council, including the "staged" construction of housing and municipal facilities. Concern about the income-mix in both old and new residential areas is an added dimension of the most recent metropolitan development planning studies.  $\frac{19}{2}$ 

 $<sup>\</sup>frac{19}{}$  State of the Region The Twin Cities Metropolitan Area, Metropolitan Council of the Twin Cities Area, 300 Metro Square Building, 7th and Robert Street, St. Paul, Minnesota, 55101, February 1977.

The larger question of an "optimal" rate of growth for the entire State economy is imbedded in the issue of industry and population redistribution in the United States. It is unlikely that the target levels of Minnesota population and employment cited earlier enforce any special discipline upon the dynamics of growth and decline in the spatial economy of the State. They depict essentially the numerical results of having Minnesota industries exercise a shared responsibility in providing roughly the number of jobs sought by the projected resident workforce in the State, given an approximate balance between total out-migration and total in-migration.

The regional economic impact forecasting and simulation system developed for the TCMA and other regions, and described in this paper, provides a readily accessible, continuously updated, and low-cost technical capability for preparing alternative growth policy scenarios which can be compared with any "official" projection series. The comparisons start with total population, labor force and employment and extend to detailed age, sex and other socio-economic attributes of these totals. The availability of alternative growth scenarios for a metropolitan region thus inforces a discipline on the current practice of regional forecasting and planning methodology by requiring at least clarification and testing of underlying assumptions.