THE CHANGING STRUCTURE OF LOCAL ECONOMIES:
Implications for Public and Private Investment in Transportation Infrastructure in the Upper Midwest[1]

By David Braslau, Candace Campbell and Wilbur Maki

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CONTENTS

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1. INTRODUCTION

There is some debate among practitioners, scholars and policy makers as to whether investments in infrastructure, particularly transportation, lead or follow economic development. No one debates the historical importance of transportation facilities in building the economies of particular port cities or transportation corridors, but these were built at a time when there was little or no competition from other transportation modes. During the past century, transportation arteries opened up centers of trade. Today, the nature of trade is global, local economies are adapting to this, and the structure of the transportation industry is very competitive. As a result, the demands for both public and private investment capital in transportation infrastructure are immense. Those of us who work in the publicly financed arenas understand that the 1990's are a time to "do more with less".

Research on the role of transportation in economic development (Forkenbrock, 1990) concludes that transportation can be a constraint to growth or development, but that economic benefits or "paybacks" on public investments are greatest in areas where there is sufficient economic activity to take advantage of the transportation improvements. For these reasons, the University of Minnesota's Center for Transportation Studies (CTS) has focused on developing a base of research which could help guide policy makers in targeting public investments in such a way as to build an efficient transportation system for the future. This would be based on an understanding of the changing nature of trade in the economy and the relationship of transportation to economic growth. This project seeks to describe the relationship of transportation to goods producers and to project how changes in the economy will influence the demand for transportation in the region in the years to come. Given that understanding, we can make policy decisions which will provide for good investment of scarce public resources.

Problem focus

This paper focuses on the changing structure of local economies in Minnesota and the Upper Midwest. We include the entire states of Iowa, North Dakota, South Dakota, and Wisconsin, as well as Minnesota, in this region.

Study objectives

The study objectives are to (1) document changes in the economic base and related economic activity of individual labor market areas and states in the Upper Midwest, with a focus on transportation system and good producers (2) analyze the linkages between these measures of

local economic structure and transportation infrastructure expenditures, and (3) present alternative scenarios of local economic change and their implications for transportation systems policy and planning in Minnesota and the Upper Midwest states.

Method of approach

The method of approach in the study of local economic change is macro-economic in its context but micro-economic in its analysis and application. This application addresses the information requirements of transportation infrastructure planning and policy issues in Minnesota and the Upper Midwest states.

This is a working paper on research in progress. The Center for Transportation Studies Transportation and the Economy Project will continue over the next year and we will attempt to delve deeper into the data and issues raised here in order to provide better knowledge for transportation system planners and users in the Upper Midwest region.

2. PRESENT AND PROSPECTIVE DEMAND FOR TRANSPORTATION SERVICES

Transportation Infrastructure of the Region

The Upper Midwest is located at the end of a distribution network. It is home to the headwaters of the Mississippi River, a major airline headquarters and mid-continent hub, and a Lake Superior port leading to the St. Lawrence Seaway. The region is crossed by numerous east-west highway and rail lines. In addition to its array of transportation modes, the Upper Midwest is approximately equidistant (1400 miles) from the east coast and the port of New Orleans, and 1800 miles from the west coast. The Upper Midwest region spans the five state region of Minnesota, Wisconsin, Iowa, North and South Dakota. The region, illustrated as a collection of BEA regions, is shown in Figure 2.1.

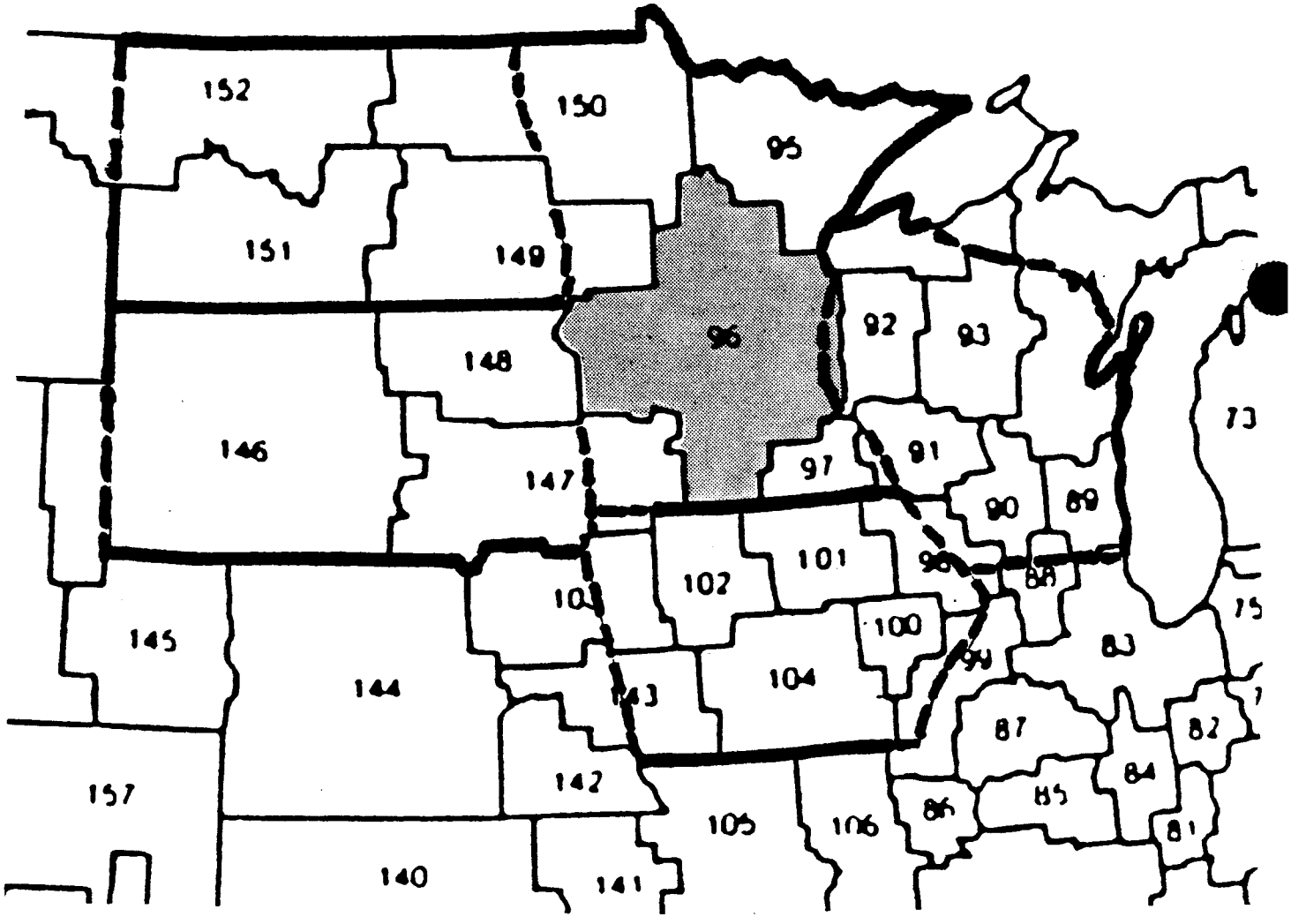
Fortunately, this region is well endowed with natural and man-made transportation routes allowing for multi-modal delivery of goods to local and global markets. The region's major industries include agricultural commodities such as grain, dairy and meat products; printing; high technology products including computers, and medical devices; and transportation equipment. Because the future of the region's economy depends on the ability to move goods to market efficiently and competitively, this paper focuses primarily on the relationship between transportation infrastructure and movement of goods rather than passenger movements. Consideration is given to the role public and private sectors in enhancing the productivity of the region's transportation system.

Interregional Trade Flows

To assess the relationship between changing local economic structure and transportation infrastructure investment, this study analyzes the present and prospective demand for transportation services within the region and outside. Goods transported outside the study region such as (counties, other substate areas, states or multi state regions) are referred to as regional exports. The destination of these exports may be either other domestic regions or foreign locations. Beginning with the state of Minnesota, a variety of data sources and methods are employed to analyze the demand for transportation services (Braslau, 1992:3). For this paper, the following interregional trade flows are considered:

> **BEA (Bureau of Economic Analysis) Region to BEA Region** using data obtained from Transearch, Inc., a subsidiary of Reebie Associates of Greenwich, Connecticut. The boundaries of the BEA regions are established by the U.S. Department of Commerce. In this analysis, BEA 96 includes the twin cities of Minneapolis and St. Paul and the surrounding area. As shown in Figure 2.1, BEA 96 is 52 of the 87 Minnesota counties, or approximately two-thirds of the state. The BEA regions within this study are further described in Appendix A. The Reebie data provide direct estimates of flows between

Figure 2.1
Upper Midwest Region by BEA Regions



BEA regions by mode. The IMPLAN[2] data base and model was used for analysis of transportation purchases by industry sectors, and for commodity (goods) exports and imports. Individual counties from the IMPLAN model are combined into appropriate BEA regions which follow county but not necessarily state boundaries. The IMPLAN model provides estimate of flows into and out of a region but not the origin or destination. These must be developed using a network model (see below) or related to data such as that provided by Reebie.

Substate region to Substate region using the IMPLAN data base and model to track substate interregional trade flows (exports and imports). Individual counties from the IMPLAN model are combined into appropriate substate planning regions. Flows between substate regions can be estimated from a network model.

County to County using the IMPLAN data base and model. County exports and imports estimated from the IMPLAN model can be compared with Reebie data for the larger BEA region and allocated according to industrial output within the BEA region and the county.

Minnesota and Twin Cities Metropolitan Area to Major U.S. Trading Partners using the Minnesota Trade Model, which incorporates an economic simulation model (IPASS) and assumptions generated by INFORUM[3] (Braslau, 1989). In this paper, the trade model is used to analyze alternative scenarios including projections to the Year 2000, new conditions brought about by EC 1992, and constraints on aviation.

Reebie Associates data. Reebie Associates data is available at the 2-digit, 3-digit or 4-digit Standard Transportation Commodity Classification (STCC) level. Except for some agricultural commodities, the STCC and SIC classifications are essentially identical. Data are provided at the 2-digit SIC level between BEA 96 (Minneapolis-St. Paul) and all of the other 183 BEAs within the United States. The data reflect exports to other states and to ports within the United States but not foreign exports that are shipped directly from a BEA. The data are provided as annual tonnages. Estimates of commodity value per pound in current dollars can also be estimated for the region by using a United States average.[4] Major shipments by value and by volume using 4- digit Reebie data for the state of Minnesota are shown in Figure 2.1.

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[2]IMPLAN- IMpact analysis for PLANning is a micro-computer based economic modelling (input-output) system created at the University of Minnesota which includes a county-level data base and makes possible the construction of detailed interindustry and intersector accounts for any county or combination of counties in the US (Olson, 1989).

[3]INFORUM refers to INter-industry FORecasting University of Maryland which has developed a linked system of international input-output models.

[4]For Minnesota (BEA 96), the 4-digit (SIC) value per pound data were weighted by 4-digit tons shipped and estimated for each 2-digit commodity.

Figure 2.2

Major Shippers from Minnesota by Value and Volume

Industry	1988 Shipments from Minnesota (tons)	Rank by Value	Rank by Volume
Computers	84,668	3	> 50
Motor Vehicles	374,427	4	29
Printed Matter	286,175	5	35
Grain	12,366,672	6	1
Periodicals	111,875	9	> 50
Books	92,847	14	> 50
Newspapers	258,271	15	39
Oil Kernels, Nuts, Seeds	2,424,302	18	4

Source: 1988 Reebie Data

State and Local Policy Program
Campbell, Petersen, Van Hattum
8-12-92

The following modal data are provided by Reebie Associates:

Rail - Carload and TOFC (Trailer on Flat Car or intermodal)
Truck - Truckload (Private/for Hire) and LTL (Less than Truck Load)
Air
Water

IMPLAN data base and model. The IMPLAN data base and model are disaggregated to the 528-industry or commodity level. For purposes of the current research, the IMPLAN results have been aggregated into a 2-digit classification. The IMPLAN data are available currently for each of the 3000+ counties in the United States for the year 1985. More recent years are being developed by the IMPLAN Group at the University of Minnesota.

The IMPLAN model provides dollar value (1985$) estimates of exports and imports for each of the regions analyzed by the model. These must be converted into tonnages using the average value per pound data obtained from Reebie Associates. The IMPLAN model also provides information on purchases of transportation services by mode. The authors are presently relating these to rate data obtained from a major transportation broker in the Twin Cities area.

Regional commodity flows by mode

Purchases of Transportation Services. Based on the IMPLAN model of Minnesota's economy in 1985, total purchases of transportation services by producers in the state totaled $2.4 million or 6 percent of total cost of production by Minnesota industry. Figure 2.2 shows the total transportation services purchased by mode and the largest industry sectors in each. The Services sector, which includes all consumer, producer and business services purchased $501 million -- 64.5 percent of these were for air services (including both freight and passenger). Among manufacturers, the industry sectors with more than $100 million in transportation purchases were food products manufacturing, construction, high-tech durable goods, other durable goods (such as munitions, machinery, instruments and electronic components), other nondurables (such as leather, apparel, chemicals and petroleum), and secondary paper products. As a percent of total production costs, the manufacturers with the largest costs for transportation are shown in Figure 2.4.

Regional flows by tonnage

Selected modal data between BEA 96 and the rest of the United States are shown in Figure 2.5 through Figure 2.15.

Figure 2.5 Shipments from the US to Minneapolis-St. Paul (tonnage)

Figure 2.6 Shipments from Minneapolis-St. Paul to the US (tonnage)

Figure 2.3

PURCHASES OF TRANSPORTATION SERVICES BY MINNESOTA PRODUCERS

PURCHASES BY MODE, 1985

AIR		$1 billion
Largest Sectors:		
Services	$501 million	
High Tech Durables	$116 million	
MOTOR FREIGHT		$888 million
Largest Sectors:		
Services	$206 million	
Transportation	$161 million	
Construction	$ 98 million	
Food Products	$ 86 million	
Ag. Producers	$ 55 million	
RAILROAD		$447 million
Largest Sectors:		
Food Products	$ 66 million	
Services	$ 51 million	
Secondary Paper	$ 48 million	
Energy	$ 41 million	
Construction	$ 34 million	
Primary Paper Products	$ 33 million	

Source: IMPLAN

Figure 2.4

PURCHASES OF TRANSPORTATION SERVICES BY MINNESOTA PRODUCERS

PERCENT OF TOTAL PRODUCTION COSTS, 1985

Secondary Paper Products Books, printed matter, published materials	19%
High Tech Non-Durables Chemicals, Synthetic materials, Petroleum	14%
Low Tech Durables Furniture Fixtures, Glass, Brick, Concrete	13%
Primary Paper Products Paper mills, Bags, Pulp Goods	12%

Source: IMPLAN

State and Local Policy Program
Campbell, Petersen, Van Hattum
8-12-92

Regional flows by value

These data reveal that rail carload continues to be a major hauler of bulk commodities into and out of the state. The reliance of Minnesota and states further east on Montana coal is clearly demonstrated by the data, with coal being the largest tonnage of any commodity imported into Minneapolis-St.Paul by any mode. As one of the region's energy resources, this bulk import is an important component of the region's ability to create value-added products for export.

The largest tonnage export from the state is Farm Products which are also carried by rail carload. Therefore, access to rail lines and continuation of the rail network is essential for Minnesota's economy.

The intermodal (or TOFC) share of rail shipments is growing especially in the small package area, with major shipments by UPS and the US Postal Service. Both of these small package shippers contract with rail carriers to reduce their costs in using a reliable delivery mode and to serve as a hub for truck pick-up. The data here show that the relative value of these shipments is considerably higher than the relative tonnage. Thus, intermodal facilities appear to be a critical element of the transportation system. These facilities (warehouses, trucking terminals, container depots and rail yards) in the Twin Cities face increasing opposition by some communities due to noise, pollution and road congestion. The increasing importance of these shipments to the region's economy should lead transportation agencies and users of these services to provide attention to the improvement of these intermodal carriers and their related services and facilities.

From US into Minneapolis-St. Paul (BEA 96)

1990 Commodity Traffic in 1000 Tons

		-------RAIL------		---FOR HIRE---		PRIVATE			
	Commodity	CARLOAD	TOFC	TL	LTL	TRUCK	AIR	WATER	TOTAL
1	Farm Products	9402.61	359.47	396.36	0	137.99	0	53.47	10349.89
9	Fresh Fish or Marine	0	0	0	0	0	0	31.28	31.28
10	Metallic Ores	0.61	0	0	0	0	0	12.2	12.81
11	Coal	18394.99	0	14.84	0	0	0	496.96	18906.79
13	Crude Petroleum or N	0	0	0	0	0	0	0.12	0.12
14	Nonmetallic Minerals	89.39	0.16	0	0	0	0	1725.79	1815.34
20	Food or Kindred Prod	1104.67	23.93	5121.73	200.66	6031.51	3.35	51.56	12537.42
21	Tobacco Products	0	0	0.78	0.47	0	0	0	1.25
22	Textile Mill Product	0	1.24	48.89	22.17	17.91	0.09	0.82	91.12
23	Apparel or Related P	0	0	20.9	35.23	22.08	0.54	0	78.75
24	Lumber or Wood Produ	660.23	36.51	874.26	4.9	1516.44	0.06	18.31	3110.72
25	Furniture or Fixture	0.96	14.18	50.73	78.21	53.03	0.25	0	197.37
26	Pulp, Paper or Allie	892.95	70.81	851.26	111.33	482.03	0.09	0.53	2409.01
27	Printed Matter	0	0	228.44	67.44	352.23	1.56	0	649.68
28	Chemicals or Allied	1471.01	42.91	897.27	328.28	855.19	0.86	359.17	3954.69
29	Petroleum or Coal Pr	302.34	0.42	1232.05	42.95	984.37	0	966.26	3528.39
30	Rubber or Misc Plast	10.13	5.8	183.16	66.79	331.47	0.42	0	597.77
31	Leather or Leather P	0	0	19.91	2.19	2.32	0	0	24.42
32	Clay, Concrete, Glas	1027.77	3.68	2940.67	57.13	8802.03	0.48	754.27	13586.03
33	Primary Metal Produc	294.38	12.01	971.3	34.98	298.74	0.19	68.91	1680.51
34	Fabricated Metal Pro	0.21	0	422.21	117.14	443.83	1.68	0	985.08
35	Machinery	4.49	0	278.36	118.35	127.3	5.71	0	534.2
36	Electrical Equipment	2.65	6.28	146.64	101.79	151.35	15.74	0	424.44
37	Transportation Equip	555.85	15.08	158.61	24.91	97.89	2.8	0	855.14
38	Instrum, Photo Equip	0	0	19.69	24.12	19.32	1.72	0	64.85
39	Misc Manufacturing P	0	0	44.34	44.52	21.8	0.12	0	110.78
40	Waste or Scrap Mater	170.12	3.81	0	0	0	0	7.14	181.07
41	Misc Freight Shipmen	0	1.6	0	0	0	0	0	1.6
42	Shipping Containers	0	100.71	0	0	0	0	0	100.71
43	Mail or Contract Tra	0	37.61	0	0	0	0	0	37.61
44	Freight Forwarder Tr	0	0	0	0	0	0	0	0
45	Shipper Association	0	2.91	0	0	0	0	0	2.91
46	Misc Mixed Shipments	0	678.01	0	0	0	0	0	678.01
	Total	34385.36	1417.13	14922.4	1483.58	20748.85	35.66	4546.78	77539.76

Figure 2.5 Shipments from the US to Minneapolis-St. Paul (tonnage)

From Minneapolis-St. Paul (BEA 96) to US

1990 Commodity Traffic in 1000 Tons

	Commodity	-------RAIL------ CARLOAD	TOFC	---FOR HIRE--- TL	LTL	PRIVATE TRUCK	AIR	WATER	TOTAL
1	Farm Products	9784.51	0.72	25.78	0	8.91	0	7861.02	17680.95
9	Fresh Fish or Marine	0	0	0	0	0	0	0	0
10	Metallic Ores	0	0	0	0	0	0	0	0
11	Coal	3079.36	0	0	0	0	0	766.91	3846.27
13	Crude Petroleum or N	0	0	0	0	0	0	0	0
14	Nonmetallic Minerals	1506.27	0	0	0	0	0	515.88	2022.15
20	Food or Kindred Prod	2585.32	76.39	5720.23	190.94	5456.46	0.05	177.33	14206.73
21	Tobacco Products	0	0	0.02	0	0	0	0	0.02
22	Textile Mill Product	0	0	7.95	3.3	14.94	0	0	26.2
23	Apparel or Related P	0	0	6.3	8.26	23.22	0.06	0	37.85
24	Lumber or Wood Produ	513.88	16.63	785.62	8.72	1085.16	0	11.83	2421.83
25	Furniture or Fixture	0	0	31.67	46.92	77.57	0	0	156.16
26	Pulp, Paper or Allie	441.75	42.62	802.7	93.47	496.41	0.43	0	1877.38
27	Printed Matter	0	0	167.95	170.99	369.31	10.86	0	719.1
28	Chemicals or Allied	1466.07	13.82	1461.34	347.39	778.85	0.24	338.64	4406.34
29	Petroleum or Coal Pr	639.77	3.97	1450.81	28.14	2230.77	0	2028.71	6382.17
30	Rubber or Misc Plast	0	1.51	23.98	20.83	366.51	0.88	0	413.7
31	Leather or Leather P	0	0	3.18	1.04	1.01	0	0	5.23
32	Clay, Concrete, Glas	0.22	0	1810.86	33.8	9231.89	0.01	485.25	11562.04
33	Primary Metal Produc	134.07	0	557.13	29.7	299.32	0.17	0	1020.38
34	Fabricated Metal Pro	0	2.59	441.15	155.66	399.04	3.66	0	1002.1
35	Machinery	2.48	0.14	239.47	149.17	143.04	16.77	0	551.07
36	Electrical Equipment	20.76	8.47	139.84	104.05	89.34	4.07	0	366.54
37	Transportation Equip	284.1	1.17	29.92	19.64	93.58	0	0	428.4
38	Instrum, Photo Equip	0	0	41.06	29.8	33.26	0.49	0	104.61
39	Misc Manufacturing P	0	0	74.97	21.88	11.4	0.38	0	108.63
40	Waste or Scrap Mater	451.52	2.28	0	0	0	0	71.64	525.45
41	Misc Freight Shipmen	0	0	0	0	0	0	0	0
42	Shipping Containers	0	32.77	0	0	0	0	0	32.77
43	Mail or Contract Tra	0	87.92	0	0	0	0	0	87.92
44	Freight Forwarder Tr	0	0	0	0	0	0	0	0
45	Shipper Association	0	0	0	0	0	0	0	0
46	Misc Mixed Shipments	0	894.41	0	0	0	0	0	894.41
	Total	20910.07	1185.4	13821.93	1463.71	21209.99	38.07	12257.22	70886.39

Figure 2.6 Shipments from Minneapolis-St. Paul to the US (tonnage)

Figure 2.7 BEA 96 Exports to US by Rail

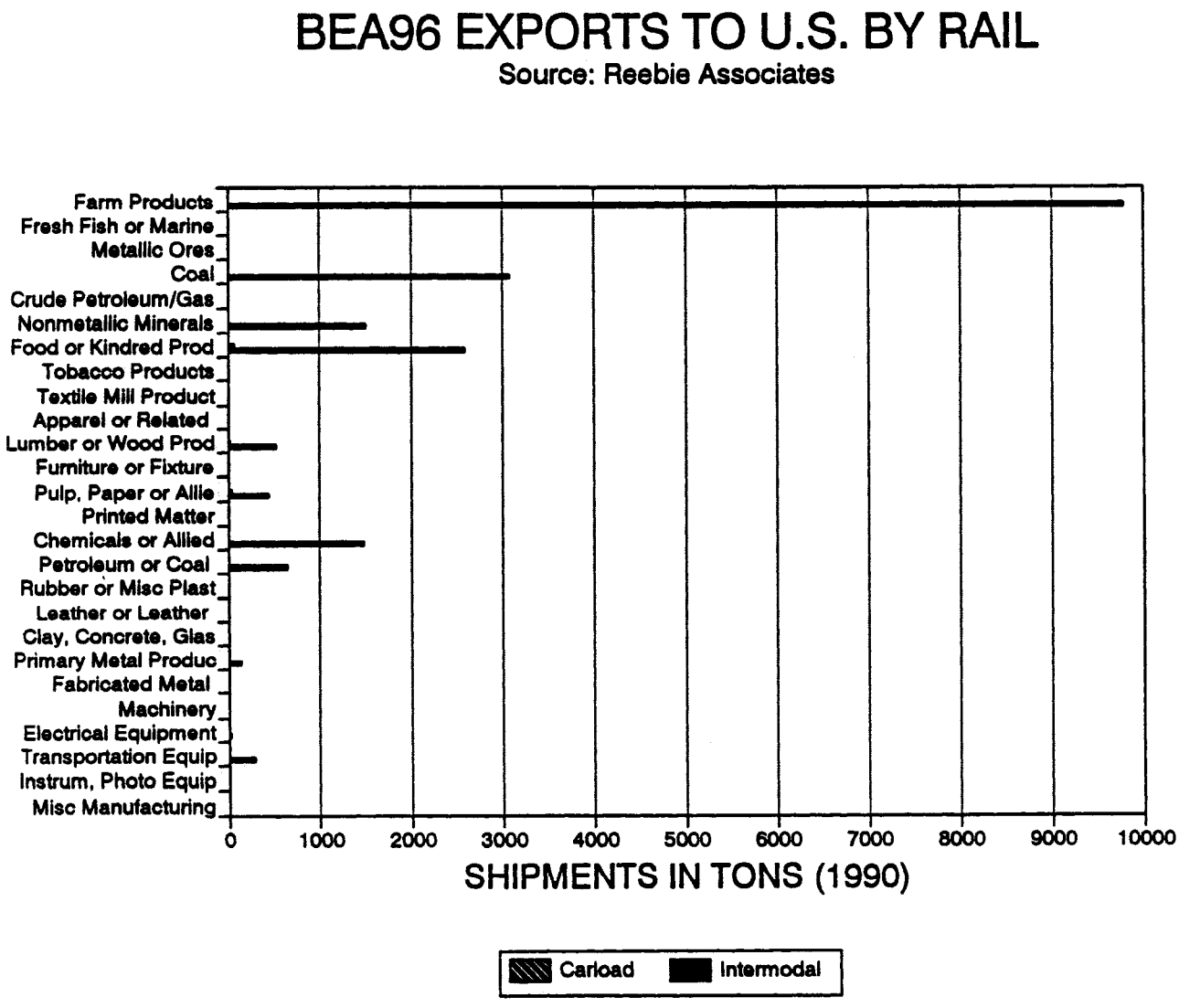


Figure 2.8 BEA 96 Exports to US by Truck

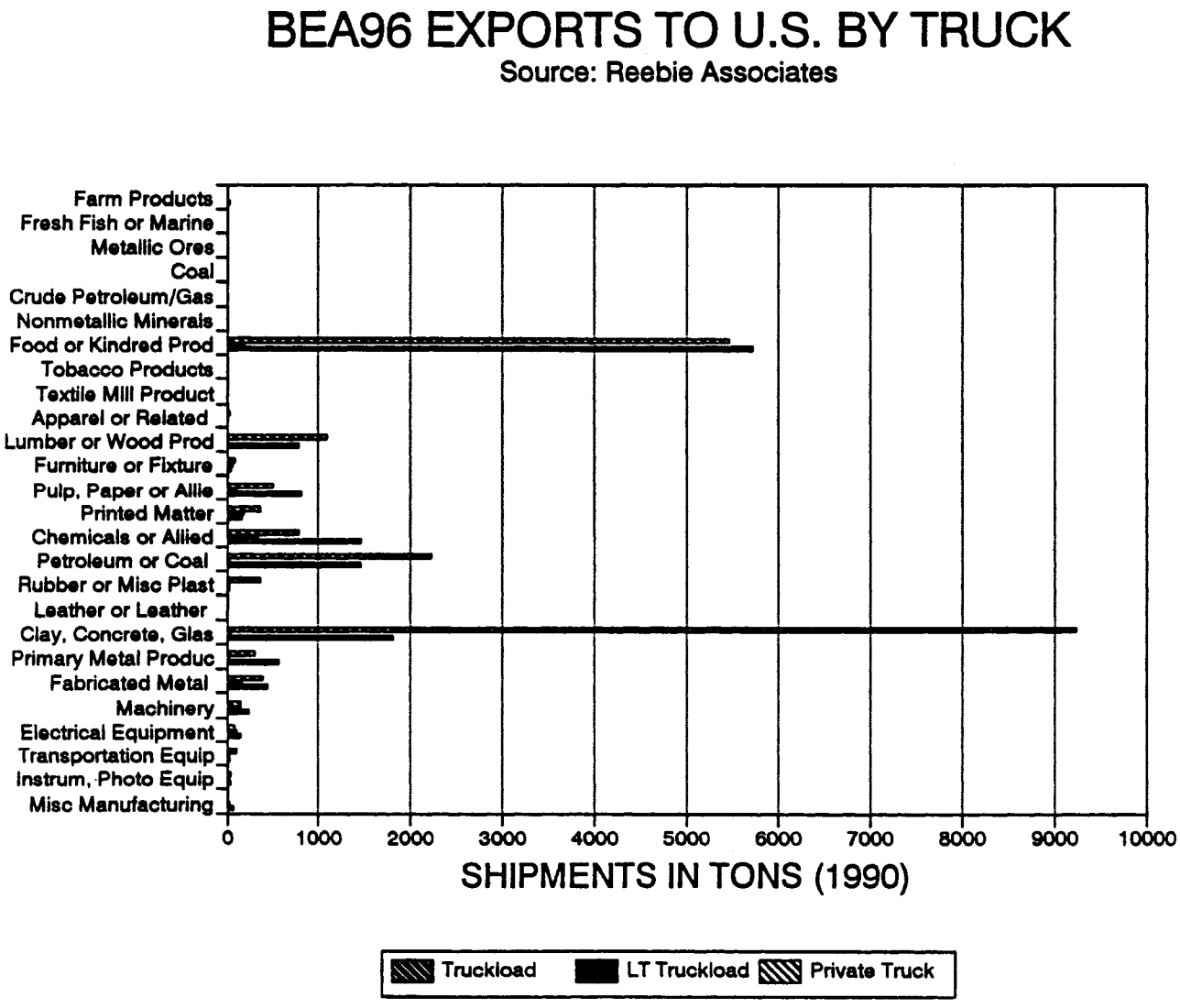


Figure 2.9 BEA 96 Exports to US by Air

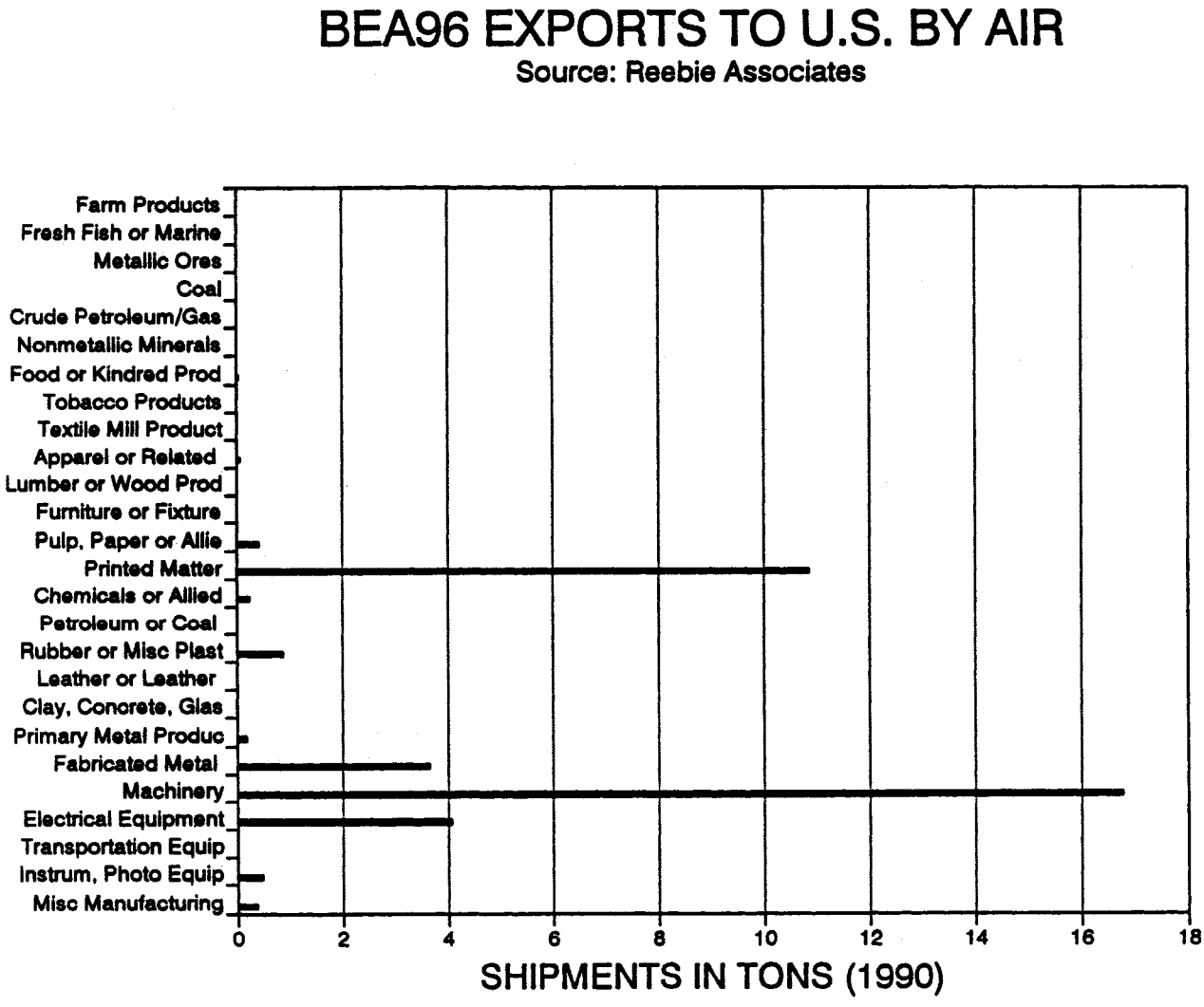
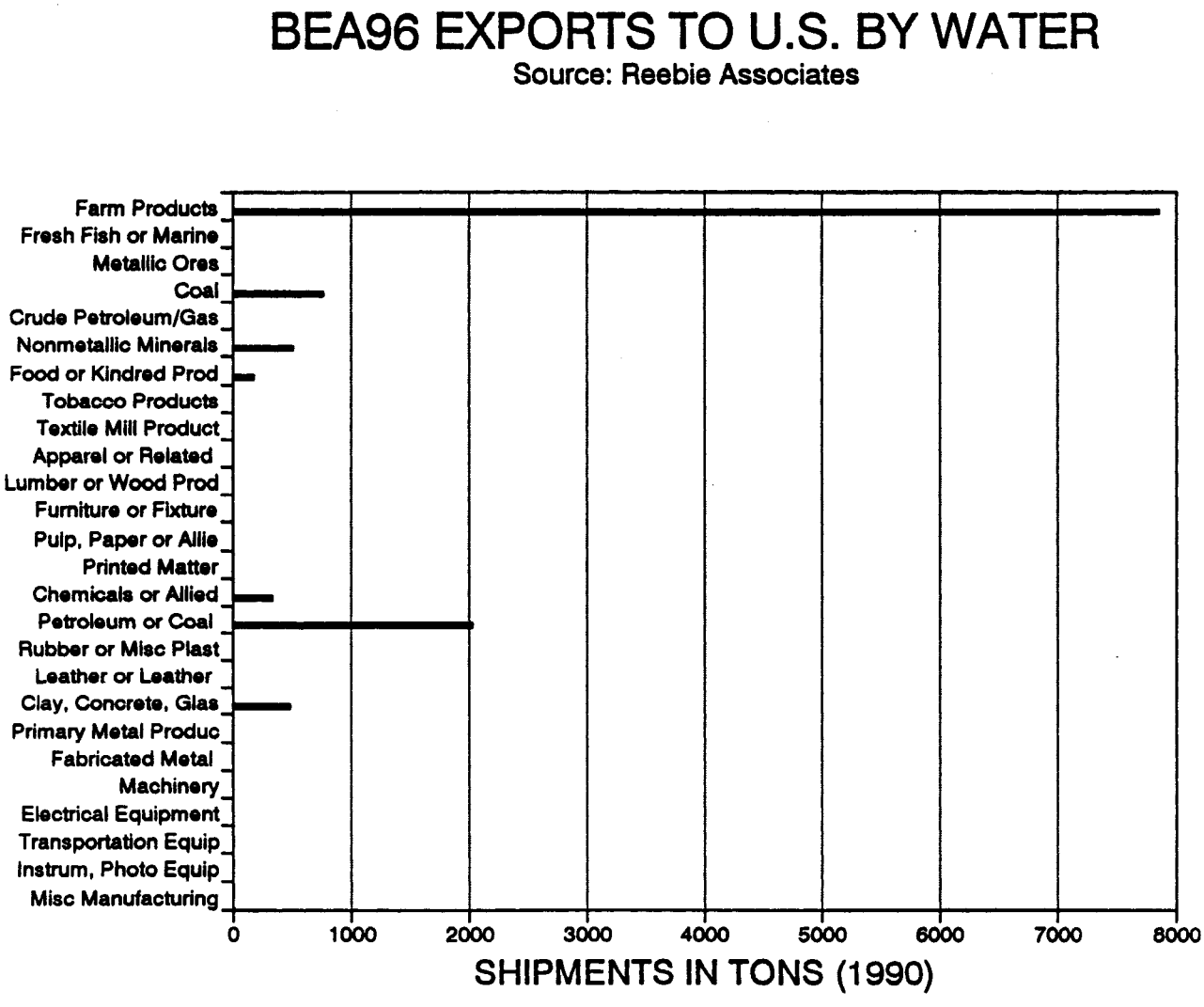


Figure 2.10 BEA 96 Exports to US by Water



From US into Minneapolis-St. Paul (BEA 96)

1990 Commodity Traffic in Million $

		-------RAIL------		---FOR HIRE---		PRIVATE			
	Commodity	CARLOAD	TOFC	TL	LTL	TRUCK	AIR	WATER	TOTAL
1	Farm Products	1090.7	41.7	45.98	0	16.01	0	6.2	1200.59
9	Fresh Fish or Marine	0	0	0	0	0	0	176.27	176.27
10	Metallic Ores	0.02	0	0	0	0	0	0.32	0.33
11	Coal	515.06	0	0.42	0	0	0	13.91	529.39
13	Crude Petroleum or N	0	0	0	0	0	0	0.02	0.02
14	Nonmetallic Minerals	1.25	0	0	0	0	0	24.16	25.41
20	Food or Kindred Prod	744.55	16.13	3452.05	135.24	4065.24	2.26	34.75	8450.22
21	Tobacco Products	0	0	21.38	13.05	0	0	0	34.43
22	Textile Mill Product	0	4.18	164.27	74.49	60.18	0.29	2.74	306.16
23	Apparel or Related P	0	0	220.43	371.63	232.88	5.66	0	830.6
24	Lumber or Wood Produ	163.74	9.05	216.82	1.22	376.08	0.02	4.54	771.46
25	Furniture or Fixture	3.88	57.2	204.64	315.52	213.93	1.02	0	796.18
26	Pulp, Paper or Allie	830.44	65.85	791.67	103.54	448.29	0.09	0.49	2240.38
27	Printed Matter	0	0	1304.42	385.1	2011.23	8.93	0	3709.68
28	Chemicals or Allied	1309.2	38.19	798.57	292.17	761.12	0.77	319.66	3519.68
29	Petroleum or Coal Pr	41.72	0.06	170.02	5.93	135.84	0	133.34	486.92
30	Rubber or Misc Plast	33.07	18.92	597.83	218.01	1081.92	1.37	0	1951.12
31	Leather or Leather P	0	0	240.98	26.5	28.12	0.02	0	295.63
32	Clay, Concrete, Glas	115.11	0.41	329.36	6.4	985.83	0.05	84.48	1521.64
33	Primary Metal Produc	283.78	11.57	936.34	33.72	287.99	0.18	66.43	1620.01
34	Fabricated Metal Pro	0.51	0	1009.94	280.2	1061.64	4.03	0	2356.31
35	Machinery	39.3	0	2437.28	1036.25	1114.6	50.03	0	4677.46
36	Electrical Equipment	42.28	100.35	2342.44	1625.93	2417.63	251.37	0	6780
37	Transportation Equip	2582.48	70.06	736.91	115.71	454.82	12.99	0	3972.97
38	Instrum, Photo Equip	0	0	397.98	487.48	390.38	34.68	0	1310.51
39	Misc Manufacturing P	0	0	286.6	287.76	140.94	0.79	0	716.09
40	Waste or Scrap Mater	82.68	1.85	0	0	0	0	3.47	88
41	Misc Freight Shipmen	0	2.65	0	0	0	0	0	2.65
42	Shipping Containers	0	249.35	0	0	0	0	0	249.35
43	Mail or Contract Tra	0	13743.92	0	0	0	0	0	13743.92
44	Freight Forwarder Tr	0	0	0	0	0	0	0	0
45	Shipper Association	0	17.69	0	0	0	0	0	17.69
46	Misc Mixed Shipments	0	4118.24	0	0	0	0	0	4118.24
	Total	7879.77	18567.38	16706.31	5815.84	16284.69	374.54	870.8	66499.33

Figure 2.11 Shipments from the US to Minneapolis-St. Paul (value)

From Minneapolis–St. Paul (BEA 96) to US

1990 Commodity Traffic in Million $

		-------RAIL------		---FOR HIRE---		PRIVATE			
	Commodity	CARLOAD	TOFC	TL	LTL	TRUCK	AIR	WATER	TOTAL
1	Farm Products	1076.3	0.08	2.84	0	0.98	0	864.71	1944.9
9	Fresh Fish or Marine	0	0	0	0	0	0	0	0
10	Metallic Ores	0	0	0	0	0	0	0	0
11	Coal	86.22	0	0	0	0	0	21.47	107.7
13	Crude Petroleum or N	0	0	0	0	0	0	0	0
14	Nonmetallic Minerals	33.14	0	0	0	0	0	11.35	44.49
20	Food or Kindred Prod	1540.85	45.53	3409.26	113.8	3252.05	0.03	105.69	8467.21
21	Tobacco Products	0	0	0.41	0	0	0	0	0.41
22	Textile Mill Product	0	0	22.93	9.52	43.09	0	0	75.55
23	Apparel or Related P	0	0	62.03	81.38	228.69	0.6	0	372.71
24	Lumber or Wood Produ	205.55	6.65	314.25	3.49	434.06	0	4.73	968.73
25	Furniture or Fixture	0	0	121.24	179.62	296.93	0	0	597.8
26	Pulp, Paper or Allie	498.29	48.07	905.44	105.43	559.95	0.49	0	2117.68
27	Printed Matter	0	0	965.38	982.84	2122.78	62.41	0	4133.42
28	Chemicals or Allied	1222.7	11.52	1218.76	289.72	649.56	0.2	282.42	3674.89
29	Petroleum or Coal Pr	85.73	0.53	194.41	3.77	298.92	0	271.85	855.21
30	Rubber or Misc Plast	0	4.92	78.37	68.08	1197.76	2.86	0	1351.98
31	Leather or Leather P	0	0	37.53	12.28	11.89	0	0	61.7
32	Clay, Concrete, Glas	0.02	0	155.73	2.91	793.94	0	41.73	994.34
33	Primary Metal Produc	167.85	0	697.53	37.19	374.74	0.21	0	1277.52
34	Fabricated Metal Pro	0	5.77	982.88	346.81	889.06	8.15	0	2232.68
35	Machinery	31.71	1.76	3059	1905.52	1827.17	214.16	0	7039.32
36	Electrical Equipment	292.84	119.51	1972.88	1467.99	1260.44	57.43	0	5171.09
37	Transportation Equip	1387.52	5.72	146.12	95.92	457.03	0	0	2092.32
38	Instrum, Photo Equip	0	0	992.41	720.25	804.06	11.94	0	2528.66
39	Misc Manufacturing P	0	0	459.54	134.14	69.9	2.35	0	665.93
40	Waste or Scrap Mater	307.94	1.56	0	0	0	0	48.86	358.35
41	Misc Freight Shipmen	0	0	0	0	0	0	0	0
42	Shipping Containers	0	81.34	0	0	0	0	0	81.34
43	Mail or Contract Tra	0	32129.44	0	0	0	0	0	32129.44
44	Freight Forwarder Tr	0	0	0	0	0	0	0	0
45	Shipper Association	0	0	0	0	0	0	0	0
46	Misc Mixed Shipments	0	5438	0	0	0	0	0	5438
	Total	6936.66	37900.41	15798.95	6560.67	15573.01	360.83	1652.82	84783.35

Figure 2.12 Shipments from Minneapolis-St. Paul to the US (value)

Figure 2.13 Intermodal Shipments from Minneapolis-St. Paul (value)

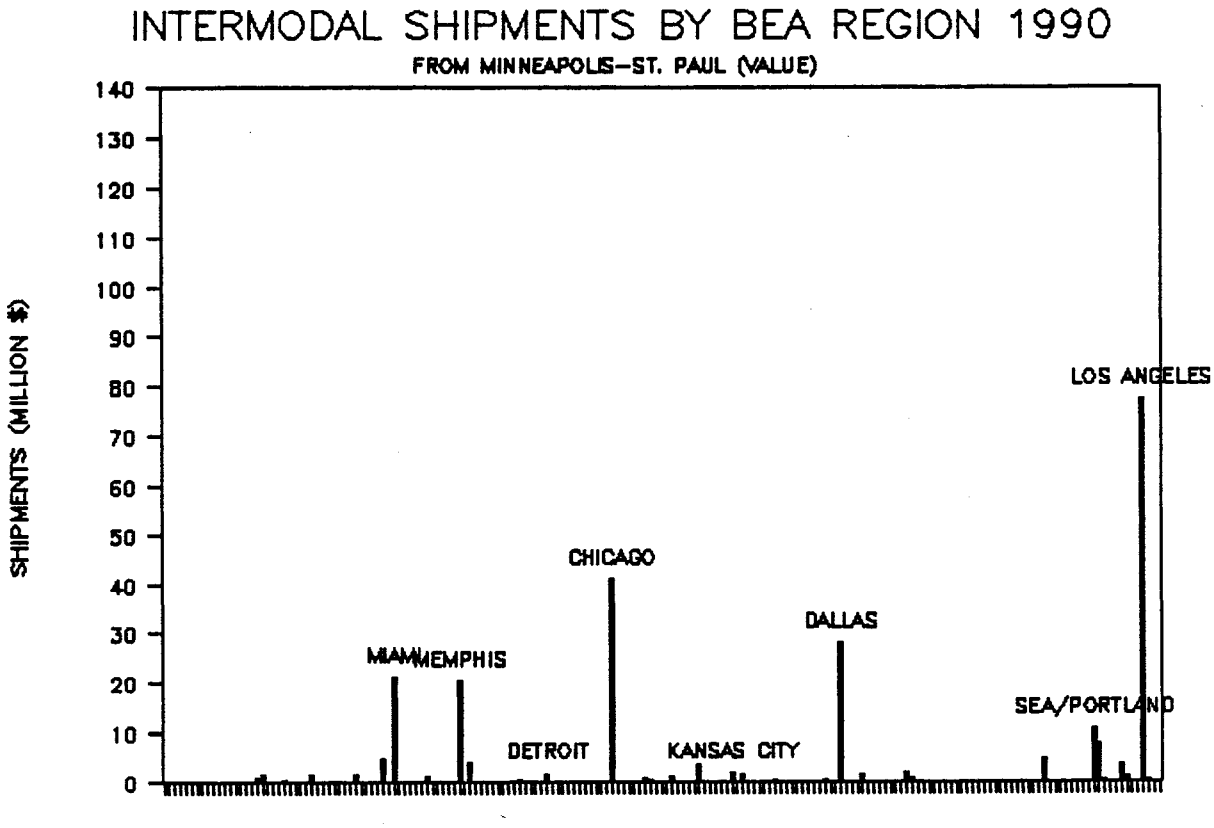


Figure 2.14 Intermodal Shipments to Minneapolis-St. Paul (value)

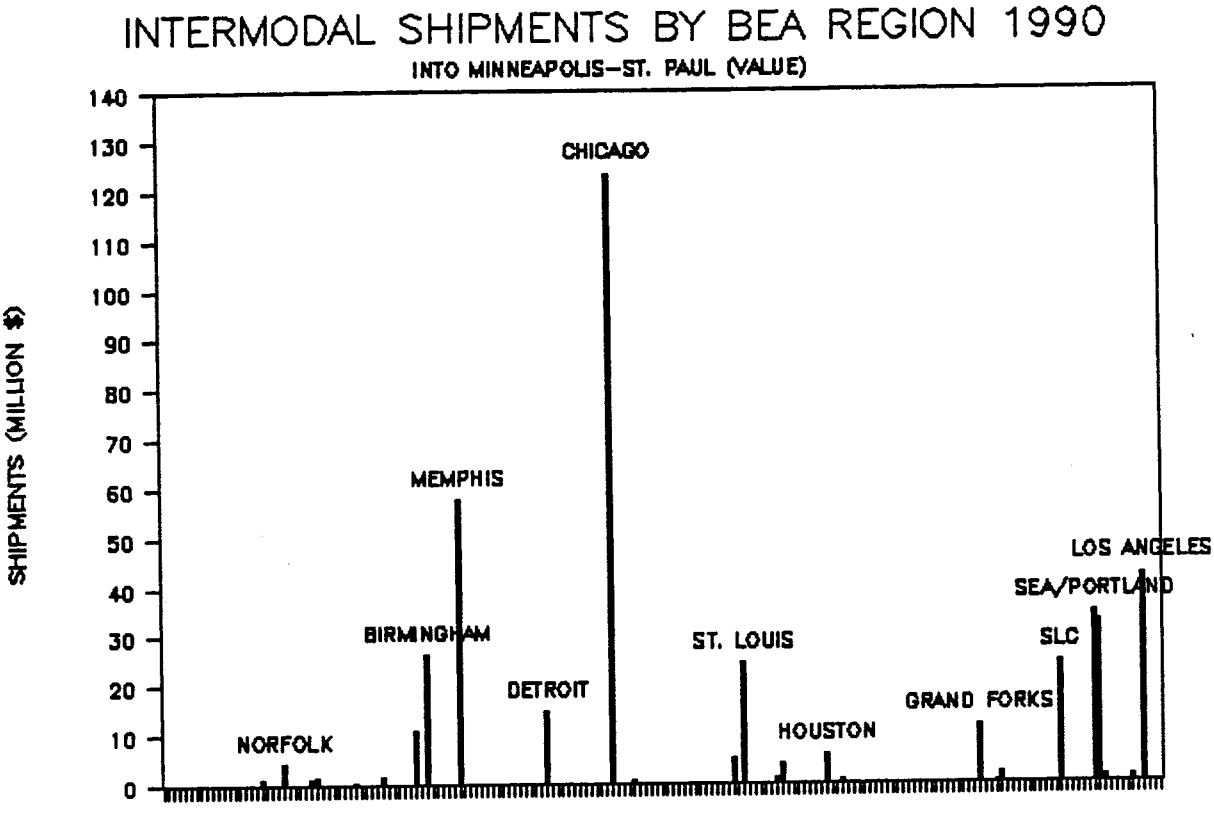


Figure 2.15 Seattle and Los Angeles Shipments (tonnage)

EXPORTS FROM MINNEAPOLIS-ST. PAUL (BEA 96)

to Seattle and Los Angeles

SECTOR	COMMODITY	SEATTLE	LOS ANGELES
20	Food/kindred products	4116	799
24	Lumber/wood products	5100	1559
26	Pulp/paper/allied products	1599	23679
28	Chemicals/allied products	799	676
29	Petroleum/coal products	515	654
35	Non-electrical machinery	138	
36	Electrical machinery	159	3481
	MANUFACTURED SUBTOTAL	12426	30848
42	Shipping containers	8066	
43	Mail/contract traffic		19479
46	Misc mixed shipments	145712	27040
	OTHER SUBTOTAL	153778	46519
	TOTAL TONNAGE	166204	77367

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Data on shipments of commodities by truck from Minneapolis-St. Paul show two commodities which represent the major share of tonnage (Figure 2.8). These are Food and Kindred Products and Clay, Concrete and Glass Products. Petroleum, chemicals, and woodproducts represent a small share of truck exports from the region. The tonnages of machinery and more advanced manufactured equipment are small compared to other commodities; however, when converted to value (Figure 2.11), these shipments take on a much greater significance. As the majority of these shipments by truck to destinations out of the state occur on the interstate network, the conditions of roadways connecting manufacturing locations with the interstate system is critical to economic efficiency.

From Figure 2.11 it can be seen that the share of value shipments by truck is about evenly distributed between contract and private carriers with LTL carriers taking a smaller share. Printed Matter and Clay/Concrete are two commodities which are dominated by private carriers. Machinery and Miscellaneous Manufacturing shipments are dominated by contract carriers.

Air shipments by value are still quite small relative to rail and truck shipments but are about 20% of the value of water shipments. Air shipments are dominated by high value non-electrical machinery (Sector 35 which includes computers). It is important not to confuse the value of commodity shipments with the cost (or rate) of shipping the commodity. This cost is reflected in the purchase of transportation services by shippers. Higher transportation rates may be related more to the *time value* placed upon the commodity by shippers than the value of the commodity being shipped. However, from the point of view of public investment in infrastructure and how that relates to the economic vitality of the region, optimizing the value of shipments by mode is essential.

Figure 2.13 and 2.14 illustrate value of shipments from BEA 96 to other U.S. destinations. These figures include industry Sectors 1-39 and exclude miscellaneous shipments. Figure 2.15 explains the relative values of classified and unclassified tonnages shipped to these destinations. Among the two destinations, where total value of shipments from BEA 96 is higher to Los Angeles, total volume of shipments to Seattle.

Intrastate commodity flows (1985)

The IMPLAN data base and model can be used as a source of regional exports and imports for regions as small as the county. By aggregating counties into substate regions, estimates of freight flows from and to these regions is also possible. While the Reebie data provide a basis for examining interstate movements of freight, the BEAs within Minnesota and most states encompass too many counties to be of much use in an analysis of intrastate flows.

IMPLAN model output. Figure 2.16 shows the 13 Economic Development Regions within the State of Minnesota. An IMPLAN model was established for each of these regions and appropriate reports generated that provide information on exports and imports. In order to demonstrate the viability of using IMPLAN data for estimating interregional trade flows, the following steps were taken:

1. Counties were aggregated into 13 development regions

2. The 528-industry sectors were aggregated into 89 2-digit sectors

3. Only domestic exports were considered

4. Total commodity imports were considered. Unlike the Minnesota Trade Model the IMPLAN model does not provide estimates of foreign imports separate from domestic imports. Therefore, total imports were analyzed here.

5. Total exports and imports for the 13 regions were subtracted from Minnesota exports and imports to yield inter regional flows within the state.

Intrastate Truck Shipments

To further simplify this analysis, only truck shipments are analyzed here. Truck shipments in tons per year have been estimated in the following way:

1. Annual value of (intrastate) exports and imports were determined by IMPLAN for the year 1985 (in 1985$)

2. 528-industries were aggregated to 2-digit industries

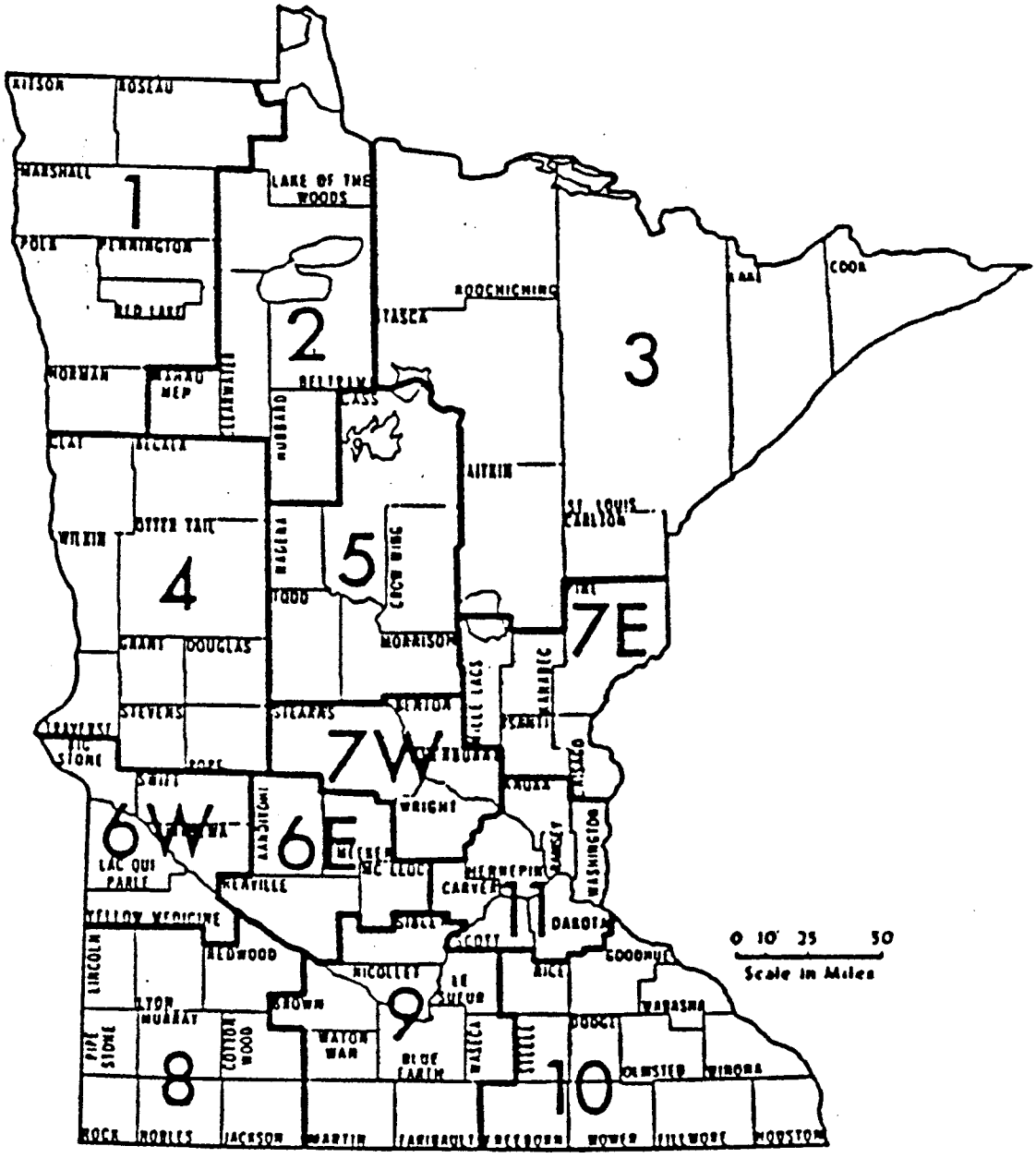
3. Value per pound data for 1989 (in 1989$) were estimated for 2-digit industries by summing tonnage-weighted 4-digit values for BEA 96

4. Approximate 1985 tonnages were estimated by dividing value by value/pound.

5. Truck share of shipments were estimated using modal shares for same industries within BEA 96 (Reebie data)

Agricultural products dominate Minnesota's intrastate truck shipments. Figure 2.17 shows the truck shipments to and from each development region in Minnesota as regional exports ("productions") and imports ("attractions"). This figure presents the eight sectors with the largest total tonnage of truck shipments within the state. Farm Products (SIC 1) are the most significant tonnages within the state at 1.4 million tons, followed by Food Products (SIC 20) at 1.0 million and Livestock at 376,000 tons. The two next largest sectors are Chemicals at 200,000 tons and Petroleum and Coal at 161,000.

Figure 2.16



MINNESOTA ECONOMIC DEVELOPMENT REGIONS

Figure 2.17

:K SHIPMENTS (000 TONS) WITHIN MINNESOTA

FARM PRODUCTS		LIVESTOCK		FOOD PRODUCTS		TIMBER PRODUCTS		PULP AND PAPER		CHEMICALS		PETRO/COAL		STONE/CLAY	
PROD	ATTR	PROD	ATTR	PROD	ATTR	PROD	ATTR	PROD	ATTR	PROD	ATTR	PROD	ATTR	PROD	ATTR
128.970	44.628	23.319	3.005	37.138	41.418	25.420	10.292	0.008	0.497	0.128	4.515	2.733	4.897	0.849	2.193
44.789	30.207	17.184	0.806	4.145	15.923	9.859	0.891	0.004	0.276	1.778	3.349	0.027	3.044	0.354	1.346
58.083	50.650	23.949	1.736	7.174	73.386	6.970	14.051	18.339	6.757	1.480	18.764	2.587	19.267	8.922	5.810
156.580	101.965	39.272	11.947	73.576	58.763	1.420	3.424	0.175	1.213	0.429	8.598	0.004	9.760	4.398	4.479
81.598	55.233	32.189	5.188	20.677	35.416	2.038	4.375	4.461	1.914	0.177	6.955	18.024	6.319	0.633	2.648
95.060	56.456	18.553	35.914	63.872	32.910	0.935	2.769	6.369	3.964	6.150	9.341	0.014	5.195	0.972	2.925
61.918	101.389	22.322	7.515	30.868	18.127	0.152	1.380	0.001	0.452	0.105	2.707	0.001	3.184	0.447	1.317
67.772	48.292	28.556	5.330	15.916	27.749	4.447	2.097	0.605	0.979	1.701	6.023	0.005	4.024	1.154	2.305
98.986	82.363	32.839	15.968	45.132	53.165	1.840	5.564	3.235	2.399	0.456	10.543	0.014	11.102	12.045	6.517
162.389	112.860	42.877	22.050	64.008	46.379	2.636	2.790	0.009	0.846	0.209	6.905	1.231	6.431	4.070	2.772
127.310	159.200	48.628	43.898	153.889	73.072	0.722	3.353	0.580	4.012	1.483	14.287	0.008	10.517	4.509	5.913
209.780	229.059	20.106	150.018	283.610	100.672	3.676	7.517	0.615	3.043	22.146	23.783	2.046	18.749	5.299	9.600
70.989	356.420	25.741	72.716	241.771	487.101	55.636	57.140	24.376	32.898	164.146	95.581	134.658	59.490	52.140	62.223
1364.224	1428.722	375.537	376.092	1041.776	1064.081	115.750	115.643	58.778	59.249	200.388	211.351	161.353	161.979	95.792	110.049

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Figure 2.18

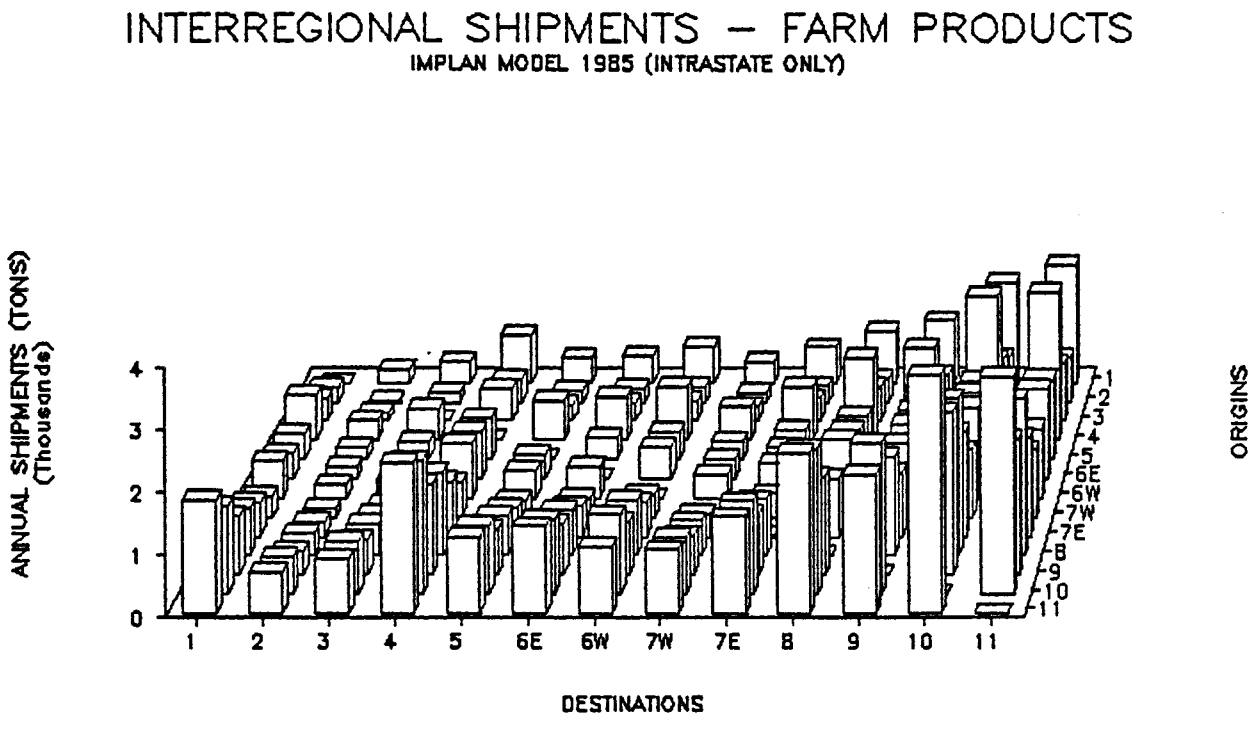

INTERREGIONAL SHIPMENTS – FARM PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
0
1
2
3
4
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11
DESTINATIONS
ORIGINS

Figure 2.19

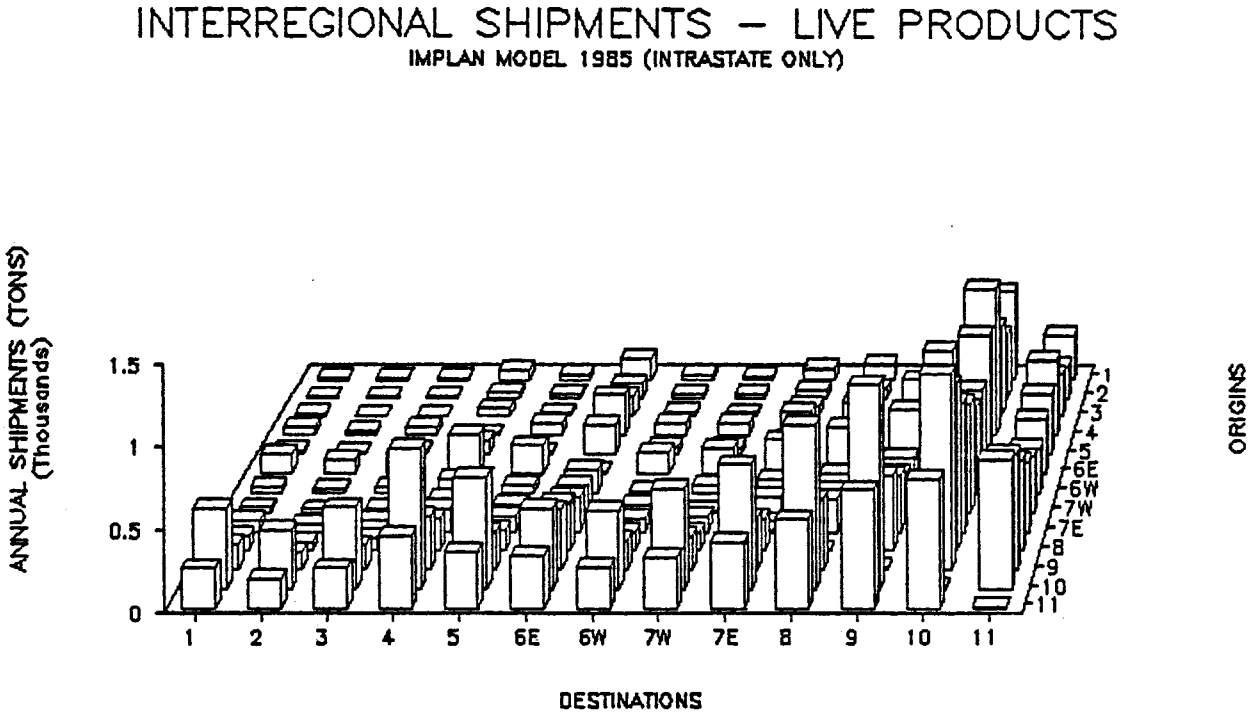

INTERREGIONAL SHIPMENTS – LIVE PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
1.5
1
0.5
0
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11
DESTINATIONS
ORIGINS

Figure 2.20

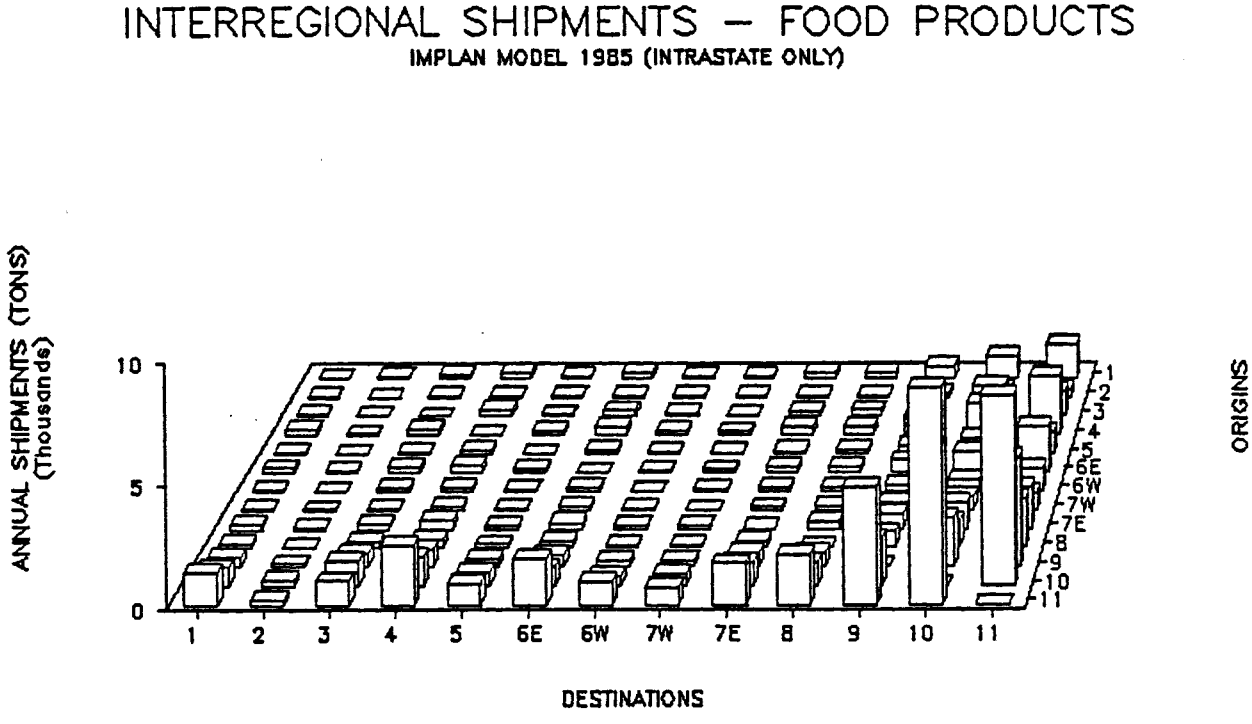

INTERREGIONAL SHIPMENTS – FOOD PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
10
5
0
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11
DESTINATIONS
ORIGINS
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11

Figure 2.21

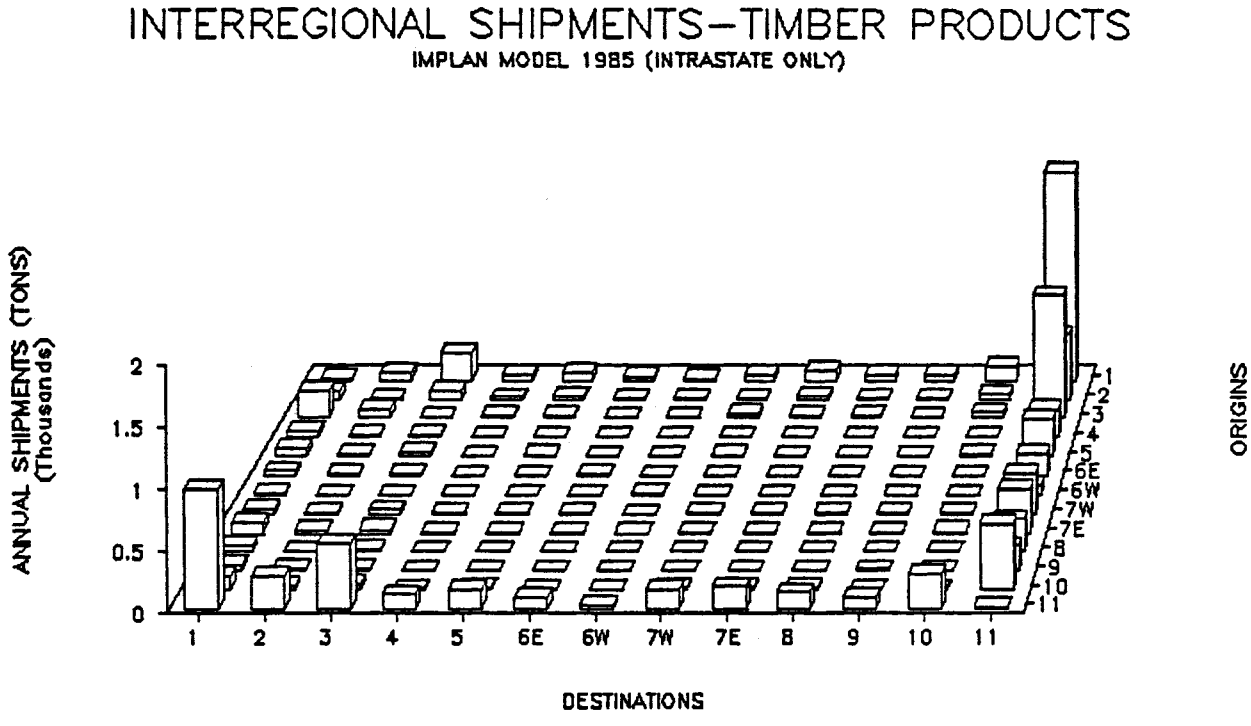

INTERREGIONAL SHIPMENTS—TIMBER PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
2
1.5
1
0.5
0
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11
DESTINATIONS
ORIGINS

Figure 2.22

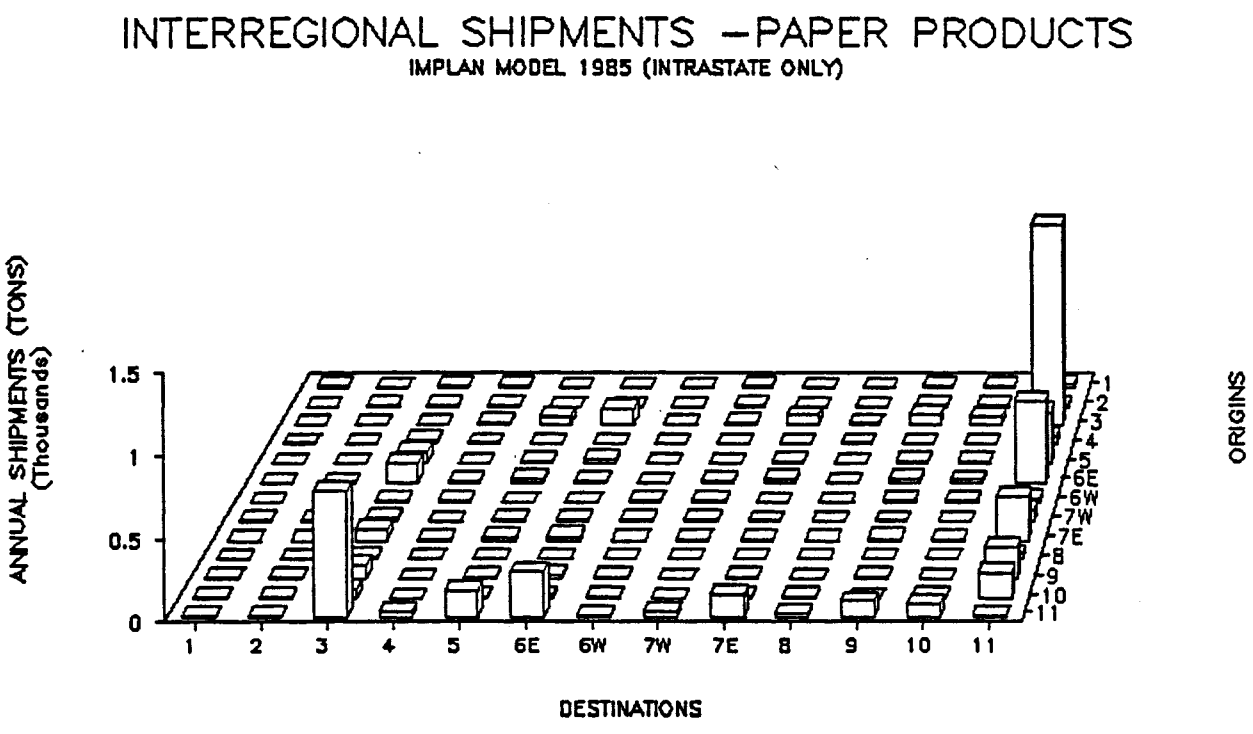

INTERREGIONAL SHIPMENTS –PAPER PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
1.5
1
0.5
0
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11
DESTINATIONS
ORIGINS
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11

Figure 2.23

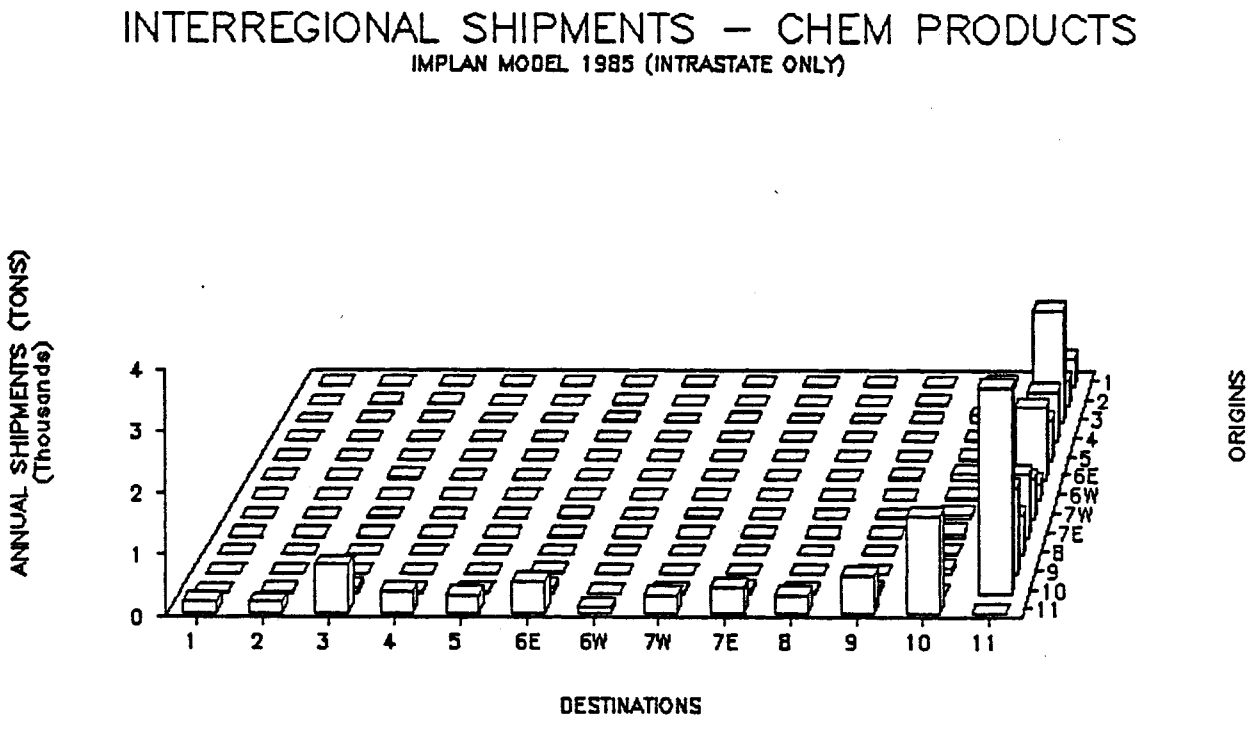

INTERREGIONAL SHIPMENTS – CHEM PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
0
1
2
3
4
1 2 3 4 5 6E 6W 7W 7E 8 9 10 11
DESTINATIONS
ORIGINS
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11

Figure 2.24

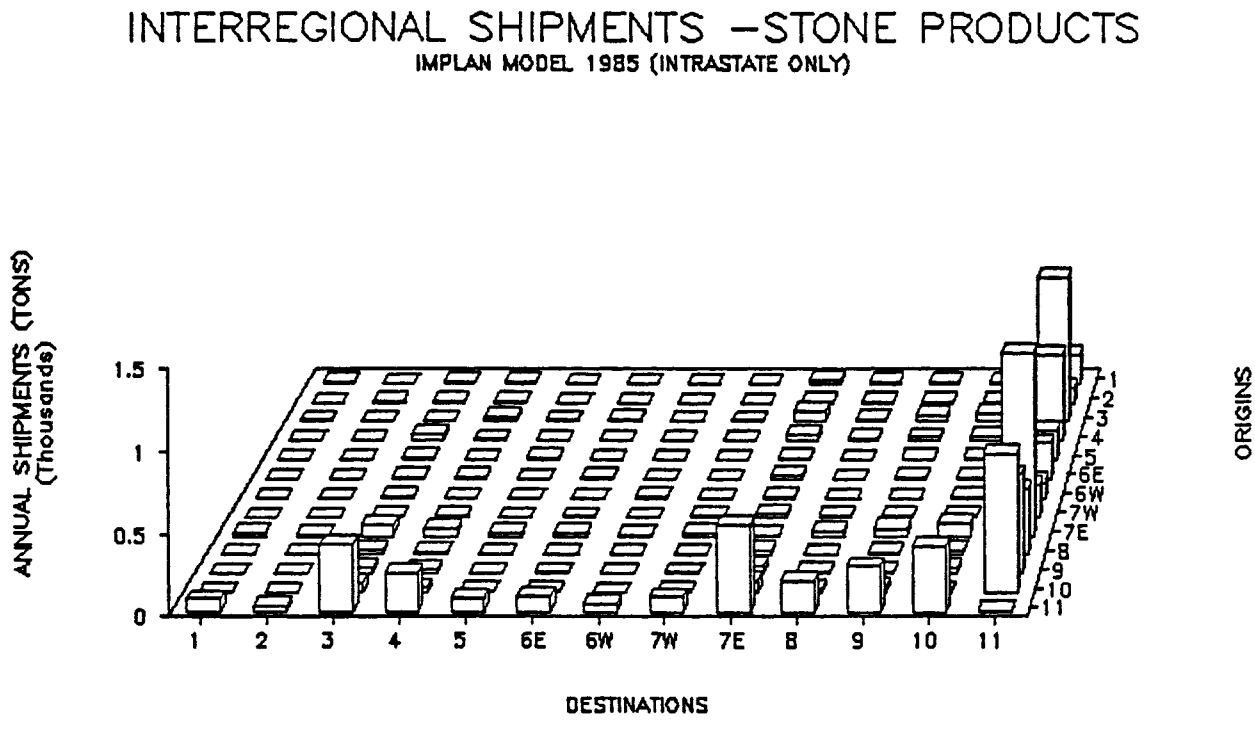
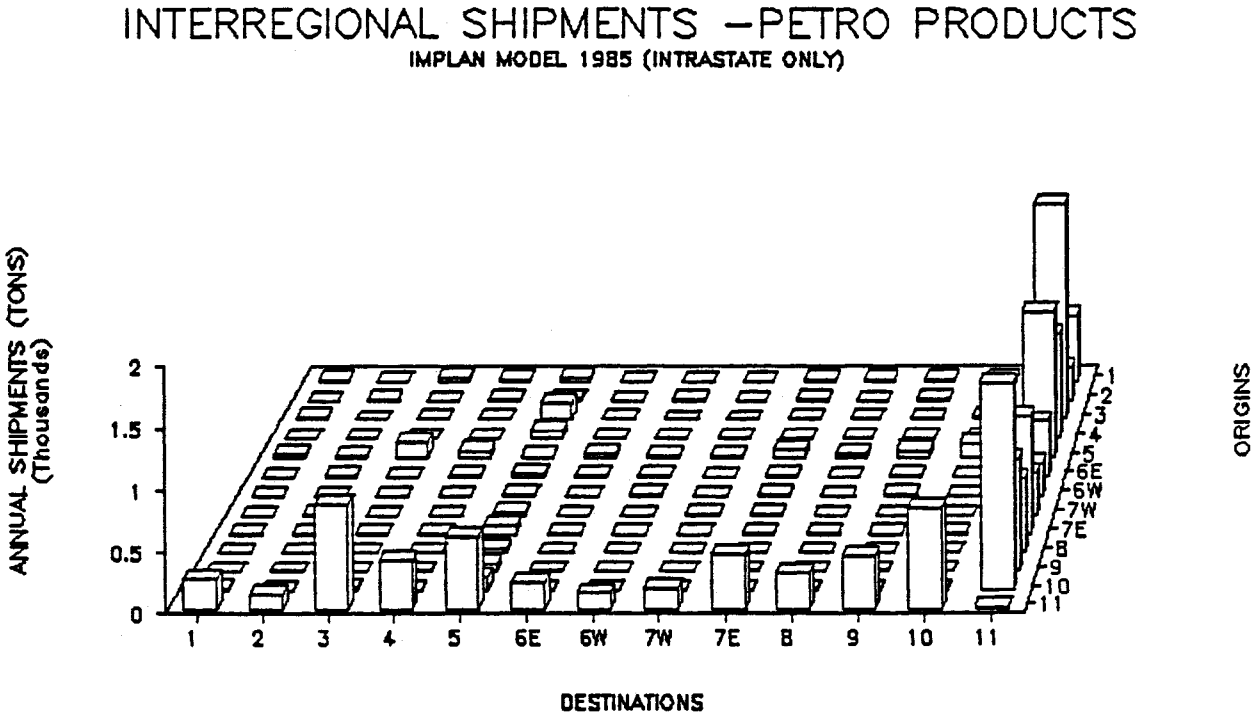

INTERREGIONAL SHIPMENTS –STONE PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
1.5
1
0.5
0
1 2 3 4 5 6E 6W 7W 7E 8 9 10 11
DESTINATIONS
ORIGINS
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11

Figure 2.25


INTERREGIONAL SHIPMENTS –PETRO PRODUCTS
IMPLAN MODEL 1985 (INTRASTATE ONLY)
ANNUAL SHIPMENTS (TONS)
(Thousands)
2
1.5
1
0.5
0
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11
DESTINATIONS
ORIGINS
1
2
3
4
5
6E
6W
7W
7E
8
9
10
11

Sectors represented in Figure 2.17 are:

Farm Products	SIC 01
Livestock	SIC 02
Food Products	SIC 20
Timber Products	SIC 24
Pulp and Paper	SIC 26
Chemicals	SIC 28
Petroleum Products	SIC 29
Stone/Clay/Concrete	SIC 32

Except for pulp and paper, these eight commodities are the only ones with annual tonnages over 100,000. Farm Products, Livestock and Food Products together account for over 80% of all shipments on Minnesota roadways. It is clear that the movement of agricultural products *within* the State of Minnesota is critical to the economic well-being of the state.

Highway network model. A simplified roadway network model connecting the 13 economic development regions in Minnesota is used to trace these intrastate flows. The links represent primarily interstate and US highways within the state. Each region (zone) is connected to the network via a "zone connector" and external (out-of-state) zones are represented by zones 14 through 20.

The Highway Emulator (THE) model was used to estimate freight trip tables between regions and to assign volumes to links on the network (Bromage, 1991). The model was reprogrammed to directly accept freight exports (productions) and imports (attractions).

Intrastate flows by tonnage. A graphical representation of the trip table for Farm Products, which represents annual shipments in tons between regions, is shown in **Figure 2.18**. It should be noted that the values represent average two-way rather than one-way volumes because of the way the program is written. Attempts are being made to rewrite that portion of the program that generates the trip table so that realistic one-way flows between regions can be obtained. However, the graphs do demonstrate the concentration of movement for most commodities between the Twin Cities Metropolitan Area and other regions of the state. Trip tables (in graphical form) for the remaining major commodities shipped by truck are shown in Figure 2.18 through Figure 2.25.

From Figure 2.18 it is clear that there is a great deal of movement of farm products within the State of Minnesota between each of its development regions. The Twin Cities (Region 11) plays a relatively large role in originating and receiving shipments (primarily between the adjacent Region 10 in SE Minnesota). Live Products (Figure 2.19) also show a relatively broad distribution of shipments throughout the state.

Food Products (Figure 2.20) shows a more narrow distribution of flows with most of the products being shipped either to the Twin Cities (Region 11) or to SE Minnesota (Region 10). There is very little movement of food products between the regions themselves.

Timber products (Figure 2.21) and Paper Products (Figure 2.22) are closely related and exhibit similar shipping behavior. By using this type of information in conjunction with a roadway network for the state, the movement of particular types of commodities on each link should be easily identifiable.

The remaining three commodities shown (Figure 2.23, Figure 2.24 and Figure 2.25) also show primarily flows to and from the regions and the Twin Cities Metropolitan Area rather than among regions. This analysis demonstrates the importance of the Twin Cities as a major market and production area for the state with radial flows of goods (and related services) reaching out to the various regions of the state. This would tend to suggest that cross-linking roadways, unless they carry interstate traffic or provide shorter travel times to the Twin Cities, do not appear to be as critical to the economy of the state as the radial roadways.

Alternative trade scenarios

Another set of data and analysis is used to measure the trade flows to foreign destinations under various assumptions: baseline, EC 1992, and constrained air transport. Each of these alternatives and their implications are set forth in the following section.

Minnesota/Metropolitan Trade Models. The Minnesota Trade Model was developed for the Minnesota Department of Trade and Economic Development beginning in 1987 (Braslau, 1989 (June 30). The base year of the model is 1987 although the model has been updated based on comparisons with later years.

The model consists of 75 industry sectors that have been selected to most effectively and accurately reflect the Minnesota economy. The model has two major components:

Bridge Module. The Bridge Module estimates the level of foreign exports from the state to major trading partners of the United States. The Bridge Module in the most recent version of the model (MTM90) has four separate world economic scenarios:

Base case (1990 base case)
High Dollar case (1990 base case)
European Community (updated to 1992 base case)
No European Community (updated to 1992 base case)

The Bridge Module also permits the user to modify Minnesota's foreign exports as a share of total United States exports.

TRIPASS Module. The TRIPASS module is a two-region version of the Minnesota IPASS model which is an economic simulation model of the state (Braslau, 1992:2). The model includes not only economic but also demographic variables, and contains an annually changing input-output table based upon data provided by the University of Maryland from which the international projections are obtained.

The TRIPASS module permits the user a wide variety of options to analyze the impacts of private and public investment scenarios in the state. The TRIPASS module currently includes a data base for the State of Minnesota and for the Twin Cities Metropolitan Area.

Baseline assumptions. Values and rates of change for a wide range of policy variables are assumed for the baseline model of the linked system of country models. Assumptions for the United States as well as the other seven countries in the system have been made. Selected growth rates for United States variables are presented in Figure 2.26.

Baseline projections to 2000. Figure 2.27 presents estimates of foreign exports by country in the year 2000 for the baseline case. From this it can be seen that Canada is our largest export destination with Japan being a close second. These account for about one-third of our total foreign exports.

As evidenced by an earlier evaluation of 15 different international trade scenarios, continued growth in Minnesota's exports and economy occur (Braslau, 1988). The base case analyzed here assumes a relative slow U.S. growth through the end of the decade, some reduction in military expenditures, and a gradually lowering U.S. dollar. The model's outcome will naturally change if any of these assumptions are modified.

Data generated and displayed in Figure 2.27 shows continued large shipments of Food and Feed and Food Products to domestic and foreign destinations. Domestic shipments of Paper Products are expected to be as large (in value) as Food and Feed Grains. Shipments of computers (in value) will dominate both domestic and foreign exports from Minnesota in the Year 2000.

EC 1992

EC 1992 assumptions. The primary assumptions included in the INFORUM linked system of country models for the EC 1992 scenario are:

- Deregulation of financial services
- Removal of border-related controls
- Increased competition in

    a) wholesale and retail trade
    b) industrial sectors and services

- Exploitation of economies of scale
- Opening up of government procurement

At the macro level, the immediate results of EC 1992 will be the reduction in production costs and significant gains in productivity. Prices will drop, increasing the competitiveness of the EC economies and thus the purchasing power of their residents. This will stimulate final demand, both domestic and foreign, giving industries the opportunity to exploit resources better and increase their level of activity and production. Inflation and unemployment will be reduced, hence offering new perspectives for growth and improving the confidence of all actors in those economies.

EC 1992 projections to 2000. The projected effect of the European Market on Minnesota's economy by the year 2000 is relatively small. The differences between foreign exports with and without the European Market are shown in Figure 2.30. This predicts a small decline in overall exports to most countries, with small increases to Belgium and France. It is also to the benefit of Minnesota that our two largest exports (Food/Feed Grains (2.) and Computers (32.)) are expected to grow slightly. While this growth is not significant, it suggests that our major exports will not be hurt by the new European Market.

Changes in other variables such as output and employment are expected to be small. For example, employment in Computers with the European Market is projected to increase from 58,811 to 59,380 or an increase of only 569.

Domestic and foreign exports by transportation mode. Purchases of transportation and transportation services for both domestic and foreign exports are identified in model output (see Figure 2.31 (1992) and Figure 2.32 (2000)). The table below shows the distribution under the European Market scenario for the year 2000.

	Domestic Export ($000)	Foreign Export ($000)
Rail transportation	$ 491,824	$83,084
Truck transportation	495,457	45,231
Water/Pipeline	158,003	15,774
Air Transportation	1,067,433	103,534
Transportation Services	22,556	8,623

This table clearly demonstrates the important role of air transportation in the shipment of domestic and foreign exports from the state. It should be noted that foreign exports for modes (other than air transportation) represent transportation margins or costs involved in moving goods to ports from which they are then exported.

baseassu.wk1 r9001-33]

BASE CASE ASSUMPTIONS FOR THE UNITED STATES

	ASSUMED EXPONTENTIAL ANNUAL GROWTH RATES (in percent)						
VARIABLE	87-90	90-91	91-92	92-93	93-94	94-95	95-2000
Gross National Product (1982$)	2.45	-0.18	1.38	2.78	1.34	1.21	1.79
Personal Consumption Expenditures	2.16	0.49	1.38	0.88	0.81	0.99	1.57
Gross Private Domestic Investment	-0.97	-6.62	7.56	10.82	3.96	2.17	2.92
Exports of Goods and Services	11.32	3.86	2.97	4.36	3.55	3.99	2.85
Imports of Goods and Services	4.04	0.89	5.11	2.42	2.21	2.27	2.38
Government Purchases							
Federal	0.4	0.23	-4.39	-3.86	-4.05	-4.22	-0.27
State and Local	2.77	0.82	0.22	2.96	1.66	1.63	1.49
Unemployment Rate	-4.29	20.02	0.63	-14.09	-1.13	3.27	-2.11
Civilian Jobs (millions)	2.35	-1.27	1.15	2.04	1.19	0.96	1.39
Civilian Labor Force	1.34	0.88	1.32	1.17	1.15	1.18	1.3
Population (millions)	1	0.44	0.8	0.76	0.73	0.69	0.62
Exchange Rates (1977$)							
Canadian Dollar	-4.23	-3.17	-0.58	-0.45	-0.45	-0.45	0
Japanese Yen	0.04	-7.28	-6.62	-3.23	-2.49	-2.55	-1.8
German Mark	-3.57	3.13	-3.49	-1.25	-1.27	-1.28	0.88

Figure 2.26

Figure 2.27

TABLE 1. EXPORT MARKET INDICATORS OF SPECIFIED SECTORS
MINNESOTA , 2000.
Based on National scenario n92 and CONSTANT MARKET SHARE

SECTOR NO.	TITLE	GROSS OUTPUT UNITED STATES	GROSS OUTPUT TOTAL REGION	DOMESTIC EXPORTS REGIONAL EXPORT	PERCENT OF U.S. GROSS OUTPUT	FOREIGN EXPORTS	TRANSHIPMENTS
		(THOU)	(THOU)	(THOU)	(PERCENT)	(THOU)	(THOU)
1	Livestock	93992128	4652835	2543072	2.7056	84469	1139
2	Food&Feed	120762000	5843609	2763599	2.2885	1599172	2275
3	Ag S Fr Fs	25090030	314853	-0	-0.0000	4429	72
4	Iron Ore M	2920404	601937	608554	20.8380	3818	13838
5	Oth Metal	6028637	32705	8646	0.1434	11203	306
6	Coal Mine	39952424	0	0	0.0000	0	0
7	Pet&Nt Gs	166023376	0	0	0.0000	0	0
8	Stne,Cly,G	10747509	94885	1301	0.0121	7096	571
9	Chm Fer Mn	5153306	0	0	0.0000	0	0
10	New Constr	198230304	4147594	758668	0.3827	0	58683
11	Maint&Repr	84874968	3203881	1839337	2.1671	0	24013
12	Ordnance	33759520	869155	839761	2.4875	21048	12592
13	Meat Prods	80325776	4079921	2219894	2.7636	86590	54540
14	Dairy Prod	44806448	2175455	1137383	2.5384	46154	29201
15	Grain Mill	41820212	1346682	1004373	2.4016	34076	19841
16	Food NEC	210108576	4148421	1718446	0.8179	135983	51528
17	Textiles	79906016	119607	80746	0.1011	10486	1755
18	Apparel& R	64082724	325557	104361	0.1629	12458	5060
19	Logging	20957696	144231	38841	0.1853	3857	1233
20	Other Wood	52963000	967508	738269	1.3939	9981	13512
21	Furn & Fix	38257408	225372	108076	0.2825	16207	3636
22	Paper&Alld	120818080	3535951	2779690	2.3007	202536	52083
23	Print&Publ	241111312	4235900	1494881	0.6200	104251	29599
24	Chem&Allid	257681744	2904134	625697	0.2428	169589	35315
25	Petrl Refn	328844320	2582195	701237	0.2132	36964	2505
26	Rubber&Pls	111174432	2273080	1988479	1.7886	207515	37542
27	Leather Pr	7211016	126798	38986	0.5407	15785	1851
28	Glass,Ston	70985472	1556501	1298113	1.8287	88440	20765
29	Ferr Metal	71228848	251293	200167	0.2810	12247	3311
30	Prm Met NE	70746384	391993	262311	0.3708	35532	4661
31	Fab Met NE	165850224	3127063	2231976	1.3458	335522	39808
32	Computers	108464560	9558230	4212880	3.8841	2889723	110591
33	Oth Ofc Eq	6008933	49966	14322	0.2383	19557	573
34	Con Min Eq	34734168	756974	232726	0.6700	596018	107270
35	NonElc NEC	183692464	5385028	2656429	1.4461	1411742	71893
36	Elc Ind Ap	41344460	1368083	615082	1.4877	414380	17025
37	House Appl	19948774	366220	269826	1.3526	66761	5290
38	Comm Equip	98182488	600153	15550	0.0158	69574	4696
39	Elc Cmp NE	70690072	1092035	522073	0.7385	161238	11299
40	Misc Elc E	56249736	1348264	813512	1.4462	251965	18130
41	Motor Vehc	226808784	1047762	504177	0.2223	294431	14267
42	Oth Tran E	126300824	394382	210339	0.1665	99467	4119
43	Prof&Scn I	21287598	975634	453774	2.1316	332123	12854
44	Med Instrm	19406778	688526	293638	1.5131	95512	8225
45	Misc Instr	41856904	663236	263142	0.6287	232601	7902
46	Misc Manuf	50700132	1230712	898702	1.7726	95370	15434
47	Railrd Trn	43626232	1112297	493940	1.1322	84272	11301
48	Lcl Transp	18919132	465941	76416	0.4039	296	4334
49	Trck Wareh	114705352	1937750	496414	0.4328	45926	11721
50	Wtr & Pipe	53080332	425231	158507	0.2986	15968	1099
51	Air Transp	111216440	2267654	1069613	0.9617	104182	723495
52	Trans Serv	16284968	222253	22594	0.1387	8638	0
53	Comm Servi	292912416	2684484	-0	-0.0000	30134	8177
54	Elec Utily	186061904	2528107	29	0.0000	850	16037
55	Gas Utilit	72605688	2126460	275131	0.3789	6692	15198
56	Watr & San	12840662	150340	0	0.0000	53	1101
57	Whlsl Trad	595539904	10526758	1829192	0.3071	515405	66874
58	Eat&Drink	180313168	5380847	1313967	0.7287	1723	116140
59	Oth Retail	436095776	9429944	2120362	0.4862	0	255385
60	Bnk & Crdt	181190304	3770102	140113	0.0773	93537	21556
61	Insurance	164891536	3437119	360984	0.2189	8323	17709
62	Real Estat	718268736	14946576	1395669	0.1943	65180	91799
63	Htls Lodgn	115540912	1134499	108325	0.0938	414	21934
64	Per & Repr	122142312	3670566	710554	0.5817	163	81087
65	Bus Servic	545608384	4281499	252	0.0000	73709	41523
66	Prof Servc	130500608	2174696	1285251	0.9849	933	56111
67	Movies&Amu	87008208	683117	43389	0.0499	3047	12441
68	Hospitals	122780600	2861991	564272	0.4596	2654	74785
69	Medical NE	181929200	5690924	1640024	0.9015	35258	150038
70	Educ Servc	40242648	826824	118794	0.2952	325	21567
71	Oth Ser NE	67635992	1790945	513627	0.7594	863	47356
72	Fed Gov En	52955280	505706	20254	0.0382	3615	2665
73	S&L Gov En	49608256	630951	53940	0.1087	2496	4351
74	Scrap,Seco	0	0	0	0.0000	0	0
75	Gov Indust	395916512	7351124	-0	-0.0000	0	0
	TOTAL	9082513408	172818992	54922648		11430525	2806583.2500

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Figure 2.28

EC199200.wk1 DIFFERENCE IN FOREIGN EXPORTS (EC 1992 COMPARED WITH BASELINE)

2000 Exports in 1982 dollars for Casem92 - Constant Share

	Canada	Japan	Belgium	France	W Germny	Italy	Nether.	U. K.	Others	Total
1. Livestock	0.002	0.004	0.295	-0.010	0.153	0.041	-0.026	-0.030	0.160	0.588
2. Food & feed grain	0.032	0.080	6.226	-0.215	3.204	0.874	-0.549	-0.620	3.362	12.393
3. Ag. ser.,for,fish	0.001	0.011	0.004	0.000	0.010	0.000	0.000	0.000	0.006	0.031
4. Iron ore mining	-0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.046
5. Other metal mining	-0.398	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.398
6. Coal mining	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000
7. Petro. & nat. gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8. Stone & clay	-0.121	-0.010	0.000	0.000	-0.001	-0.003	-0.001	-0.003	-0.004	-0.142
9. Chem & fer.minerals	-0.004	-0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.004
10. New construction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11. Maint. & repair	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12. Ordnance & accessorie	-0.108	-0.003	0.003	0.023	-0.009	0.001	-0.009	-0.023	-0.012	-0.137
13. Meat products	0.694	0.170	0.010	0.021	-0.135	-0.006	-0.525	-0.016	0.779	0.993
14. Dairy products	0.421	0.103	0.006	0.013	-0.082	-0.004	-0.319	-0.010	0.473	0.603
15. Grain mill	0.267	0.065	0.004	0.008	-0.052	-0.002	-0.202	-0.006	0.299	0.381
16. Food,NEC & tobacco	1.135	0.278	0.016	0.034	-0.220	-0.010	-0.858	-0.026	1.274	1.624
17. Textile goods	-0.048	-0.002	0.000	0.006	-0.005	0.080	-0.070	-0.081	-0.025	-0.144
18. Apparel & rel.prod.	-0.044	-0.039	-0.002	-0.003	-0.039	0.076	-0.040	-0.084	-0.070	-0.245
19. Logging	-0.197	-0.029	-0.000	-0.001	-0.005	-0.002	0.000	-0.003	-0.009	-0.247
20. Other wood products	-0.338	-0.050	-0.001	-0.002	-0.009	-0.003	0.000	-0.004	-0.016	-0.423
21. Furniture & fixtures	-0.227	-0.022	0.007	-0.004	-0.020	-0.004	-0.018	-0.106	-0.082	-0.476
22. Paper & allied	-0.607	0.480	0.045	-0.264	-0.656	-0.049	-1.040	-0.426	0.170	-2.348
23. Printing & publish.	-0.228	0.002	-0.038	0.186	-0.084	-0.030	-0.037	-0.295	-0.043	-0.567
24. Chemical & allied	-1.234	-0.357	0.056	0.062	-0.124	-0.166	-0.574	-0.798	-0.594	-3.730
25. Petroleum refining	-0.036	-0.003	0.297	0.000	0.001	0.002	0.000	-0.000	-0.004	0.256
26. Rubber & plastics	-2.066	-0.792	-0.016	-0.421	-1.585	-0.266	-1.689	-1.121	-1.027	-8.982
27. Leather products	0.001	0.015	-0.000	-0.001	-0.055	0.000	-0.000	-0.028	0.025	-0.043
28. Glass, stone, clay	0.134	-0.005	0.040	-0.051	-0.248	-0.062	-0.064	-0.306	-0.067	-0.628
29. Ferrous metals	0.032	0.102	-0.003	-0.028	-0.002	-0.009	-0.147	-0.026	0.015	-0.066
30. Primary met.,NEC	-0.218	0.099	-0.008	-0.022	-0.031	-0.011	-0.138	-0.075	0.018	-0.387
31. Fabri. metal,NEC	-2.315	0.282	0.014	0.225	0.034	-0.062	-0.560	-1.185	-0.110	-3.678
32. Computers	2.163	16.780	0.349	10.330	5.345	4.320	-1.056	-5.751	12.745	45.225
33. Other office equip.	-0.080	-0.017	-0.004	-0.030	-0.092	-0.069	-0.051	-0.166	-0.064	-0.573
34. Const & mining equip.	-14.307	-13.337	-0.455	-5.878	-11.125	-6.247	-1.724	-7.804	-7.499	-68.374
35. Nonelec. mach. NEC	-10.392	-3.575	-0.188	-0.738	-5.010	-2.544	-2.579	-11.471	-5.345	-41.841
36. Elect.ind.appara.	-3.202	-0.854	-0.132	0.204	-1.246	-0.777	-4.676	-2.494	-1.963	-15.140
37. Household applien.	-0.530	-0.157	-0.051	-0.207	-0.305	-0.230	-1.511	-0.555	-0.421	-3.967
38. Communi. equip.	-0.449	-0.236	-0.046	-0.006	-0.133	-0.166	-0.583	-0.271	-0.571	-2.462
39. Elec,compon,accesso.	-1.167	-0.614	-0.119	-0.016	-0.346	-0.432	-1.514	-0.705	-1.483	-6.396
40. Misc.elec.equip.	-0.541	0.173	0.003	0.337	-0.186	-0.018	-1.638	-0.901	-0.059	-2.829
41. Motor vehicles	-3.911	-0.124	0.009	0.165	-0.081	-0.025	-0.162	-0.512	-0.525	-5.165
42. Other trans.equit.	-1.883	-0.045	0.016	0.335	-0.115	0.011	-0.073	-0.208	-0.133	-2.094
43. Prof. & scien.ins.	-0.451	0.040	0.031	0.601	-0.991	-0.074	-1.511	-1.604	-0.405	-4.363
44. Medical ins.& sup.	-0.124	0.011	0.009	0.166	-0.273	-0.021	-0.416	-0.442	-0.111	-1.202
45. Misc.instru. prod.	-0.336	0.030	0.023	0.448	-0.738	-0.055	-1.125	-1.195	-0.301	-3.250
46. Misc. manufact.	-0.218	0.014	-0.013	-0.207	-0.648	-0.072	-1.103	-2.839	-0.067	-5.153
47. Railroad trans.	-0.316	-0.052	0.049	0.060	-0.093	-0.001	-0.204	-0.313	-0.306	-1.177
48. Local trans & interci	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49. Trucking	-0.186	-0.037	0.026	0.032	-0.054	-0.002	-0.116	-0.178	-0.188	-0.704
50. Water & pipe lines	-0.058	-0.005	0.011	0.014	-0.017	0.001	-0.041	-0.062	-0.049	-0.206
51. Air transportation	-0.236	0.078	0.094	0.112	-0.072	0.022	-0.234	-0.354	-0.073	-0.665
52. Tran. services	-0.005	0.013	0.007	0.008	-0.002	0.002	-0.012	-0.018	0.013	0.005
53. Communications ser.	-0.052	0.006	0.015	0.018	-0.016	0.003	-0.044	-0.067	-0.031	-0.167
54. Electric utilities	-0.001	0.001	0.001	0.001	-0.000	0.000	-0.002	-0.003	0.001	-0.000
55. Gas utilities	-0.026	-0.005	0.002	0.005	-0.008	-0.001	-0.016	-0.024	-0.026	-0.098
56. Water & sanitation	-0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	-0.001	-0.000	-0.001
57. Wholesale trade	-2.146	-0.479	0.265	0.341	-0.635	-0.033	-1.306	-2.004	-2.251	-8.248
58. Eating & drink.places	-0.003	0.002	0.002	0.002	-0.001	0.000	-0.004	-0.006	0.001	-0.006
59. Other retail trade	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60. Bank. & cred.agencies	-0.275	0.009	0.069	0.083	-0.083	0.009	-0.216	-0.329	-0.195	-0.928
61. Insurance	-0.025	0.001	0.006	0.007	-0.007	0.001	-0.019	-0.029	-0.017	-0.083
62. Real Estate	-0.172	0.026	0.054	0.064	-0.051	0.009	-0.148	-0.226	-0.093	-0.537
63. Hotels & lodging	-0.000	0.001	0.000	0.000	-0.000	0.000	-0.001	-0.001	-0.000	-0.002
64. Perso. & repair ser.	-0.000	0.000	0.000	0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
65. Business services	-0.255	0.077	0.098	0.116	-0.078	0.022	-0.249	-0.376	-0.087	-0.732
66. Professional ser.NEC	-0.001	0.001	0.001	0.001	-0.000	0.000	-0.002	-0.002	0.001	-0.001
67. Movies & amusement	-0.006	0.003	0.003	0.003	-0.002	0.001	-0.007	-0.010	-0.001	-0.015
68. Hospitals	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69. Medical ser. NEC	-0.149	0.000	0.000	0.196	0.000	0.000	-0.175	0.000	0.000	-0.127
70. Educational ser.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
71. Other ser. NEC	-0.001	0.001	0.001	0.001	-0.000	0.000	-0.001	-0.002	0.001	-0.001
72. Fed.gov't. ent.	-0.007	0.003	0.003	0.004	-0.002	0.001	-0.008	-0.011	-0.001	-0.019
73. S & L gov't.ent	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000
74. Scrap,used, sec.	-0.134	0.003	0.033	0.040	-0.040	0.005	-0.103	-0.157	-0.096	-0.452
75. Government industry	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-45.003	-1.883	7.126	6.171	-17.068	-5.977	-29.495	-46.362	-5.081	-137.573

Regional Econometrics 7-10-1992

Figure 2.29

TABLE 1. EXPORT MARKET INDICATORS OF SPECIFIED SECTORS
MINNESOTA , 1992.
Based on National scenario y92 and CONSTANT MARKET SHARE

SECTOR NO.	TITLE	GROSS OUTPUT: UNITED STATES	GROSS OUTPUT: TOTAL REGION	DOMESTIC EXPORTS: REGIONAL EXPORT	PERCENT OF U.S. GROSS OUTPUT	FOREIGN EXPORTS	TRANSHIPMENTS
		(TBOU)	(TBOU)	(TBOU)	(PERCENT)	(TBOU)	(TBOU)
1	Livestock	84959968	3579630	2263781	2.6645	69888	735017
2	Food&Feed	108931944	4379439	2455009	2.2537	1344654	970201
3	Ag S Fr Fs	22634428	257613	-0	-0.0000	4019	41057
4	Iron Ore M	2896902	657564	654351	22.5879	4125	2488
5	Oth Metal	5415294	30051	8418	0.1555	10968	6
6	Coal Mine	34812556	0	0	0.0000	0	0
7	Petr&Nt Gs	159362432	0	0	0.0000	0	0
8	Stne,Cly,G	8847151	75904	982	0.0111	6210	14
9	Chm Fer Mn	4307385	0	0	0.0000	0	0
10	New Constr	158020304	3554550	596676	0.3776	0	15312
11	Maint&Repr	67658504	2564811	1446598	2.1381	0	2531
12	Ordnance	28869950	761705	733159	2.5395	15759	1941
13	Meat Prods	74698928	3843629	2163597	2.8964	74430	1997
14	Dairy Prod	41650184	2066739	1108072	2.6604	40726	1096
15	Grain Mill	38861920	1296062	978178	2.5171	29317	892
16	Food NEC	195309136	3861001	1674169	0.8572	116626	1986
17	Textiles	68910992	98939	65557	0.0951	9754	151
18	Apparel& R	57512208	296254	108184	0.1881	10662	549
19	Logging	17221154	112617	27278	0.1584	6693	86
20	Other Wood	43516744	709764	518438	1.1914	13821	1097
21	Furn & Fix	31779618	186147	89482	0.2816	8971	470
22	Paper&Alld	103746048	2960932	2312512	2.2290	150276	5095
23	Print&Publ	200863280	3282708	1091208	0.5433	84517	2343
24	Chem&Allid	220995056	2367919	494520	0.2238	140253	1305
25	Petrl Refn	310337888	2325630	689814	0.2223	33827	1233
26	Rubber&Pls	86157184	1589111	1357682	1.5758	148603	3852
27	Leather Pr	6804157	105156	30977	0.4553	15314	145
28	Glass,Ston	55026020	1127723	916354	1.6653	64745	1725
29	Ferr Metal	67070452	222569	173145	0.2582	14091	523
30	Prm Met NE	55388308	287992	188657	0.3406	28602	583
31	Fab Met NE	128427320	2120691	1472492	1.1466	199281	3313
32	Computers	70365352	6302268	2864891	4.0715	1772212	12721
33	Oth Ofc Eq	4993565	38182	12476	0.2498	12151	39
34	Con Min Eq	20686880	400224	130684	0.6317	248643	1792
35	NonEle NEC	138543600	3711813	1889004	1.3635	882255	4229
36	Ele Ind Ap	29825900	973161	465123	1.5595	277687	2059
37	House Appl	15720184	298176	222886	1.4178	47995	740
38	Comm Equip	72839040	429870	12092	0.0166	50907	589
39	Ele Cmp NE	52087264	794089	403239	0.7742	119814	1444
40	Misc Ele E	43206044	1082077	655007	1.5160	182913	1485
41	Motor Vehc	189573760	852791	397087	0.2095	240183	1640
42	Oth Tran E	113291392	360282	210248	0.1856	74584	641
43	Prof&Sen I	16296586	715848	327495	2.0096	215150	1208
44	Med Instrm	14937342	515839	213072	1.4264	62583	607
45	Misc Instr	32131314	476273	190434	0.5927	148768	620
46	Misc Manuf	44434516	1102440	810369	1.8237	82185	1475
47	Railrd Trn	38398188	984739	445246	1.1595	60869	713
48	Lcl Transp	15580293	393130	62271	0.3997	198	164
49	Trck Wareh	94605264	1534415	396118	0.4187	28888	608
50	Wtr & Pipe	43998176	357096	137543	0.3126	12285	134
51	Air Transp	87011736	2222832	817533	0.9396	72965	1237
52	Trans Serv	12234416	174679	14530	0.1188	6872	73
53	Comm Servi	226721600	1923295	-0	-0.0000	23144	794
54	Elec Utily	161810272	2050034	27	0.0000	826	871
55	Gas Utilit	67514224	2020726	273374	0.4049	3870	641
56	Watr & San	11144104	125318	0	0.0000	40	53
57	Whlsl Trad	487174304	8127214	1488650	0.3056	368873	12434
58	Eat&Drink	156219360	4419377	1125794	0.7206	1412	77716
59	Oth Retail	383360672	7917687	1843328	0.4808	0	148853
60	Bnk & Crdt	154192384	3054521	118907	0.0771	67066	12552
61	Insurance	140564016	2780010	297949	0.2120	5959	10228
62	Real Estat	636281344	12186509	1160412	0.1824	49495	43963
63	Htls Lodgn	102907456	922231	98420	0.0956	328	11570
64	Per & Repr	98044232	2931021	540618	0.5514	134	35325
65	Bus Servic	432783360	3108111	189	0.0000	57722	22211
66	Prof Servc	113351072	1831541	1058128	0.9335	582	29354
67	Movies&Amu	74846808	544988	36040	0.0482	2498	5012
68	Hospitals	106615400	2456399	499350	0.4684	2654	40398
69	Medical NE	157976496	4901301	1451332	0.9187	21095	81912
70	Educ Servc	34944320	693521	99972	0.2861	325	11349
71	Oth Ser NE	58645336	1502381	437779	0.7465	556	25250
72	Fed Gov En	48810568	443161	18707	0.0383	2855	2041
73	S&L Gov En	43662212	533960	47572	0.1090	1821	2651
74	Scrap,Seco	0	0	0	0.0000	0	0
75	Gov Indust	389864416	6621327	-0	-0.0000	0	0
	TOTAL	7729188864	139537728	44893184		7857494	2406404.0000

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Figure 2.30

TABLE 1. EXPORT MARKET INDICATORS OF SPECIFIED SECTORS
MINNESOTA , 2000.
Based on National scenario y92 and CONSTANT MARKET SHARE

SECTOR NO.	TITLE	GROSS OUTPUT UNITED STATES	GROSS OUTPUT TOTAL REGION	DOMESTIC EXPORTS REGIONAL EXPORT	PERCENT OF U.S. GROSS OUTPUT	FOREIGN EXPORTS	TRANSHIPMENTS
		(THOU)	(THOU)	(THOU)	(PERCENT)	(THOU)	(THOU)
1	Livestock	94075536	4659238	2545328	2.7056	85144	1044
2	Food&Feed	120872688	5861263	2766132	2.2885	1611570	2095
3	Ag S Fr Fs	25113350	315388	-0	-0.0000	4452	65
4	Iron Ore M	2892794	599039	602801	20.8380	3735	10624
5	Oth Metal	6000610	32270	8606	0.1434	10841	249
6	Coal-Mine	39910828	0	0	0.0000	0	0
7	Petr&Nt Gs	165860256	0	0	0.0000	0	0
8	Stne,Cly,G	10704542	94727	1296	0.0121	6964	471
9	Chm Fer Mn	5126791	0	0	0.0000	0	0
10	New Constr	198236992	4155375	758694	0.3827	0	49849
11	Maint&Repr	84877816	3208261	1839399	2.1671	0	19126
12	Ordnance	33564416	865143	834908	2.4875	20638	11048
13	Meat Prods	80348512	4087862	2220522	2.7636	87591	48326
14	Dairy Prod	44818020	2179754	1137677	2.5384	46685	25873
15	Grain Mill	41829668	1349330	1004600	2.4016	34465	17657
16	Food NEC	210162896	4157061	1718890	0.8179	137533	45495
17	Textiles	79801136	119485	80640	0.1011	10355	1566
18	Apparel& R	63870964	325395	104016	0.1629	12246	4500
19	Logging	20909524	143867	38752	0.1853	3606	1097
20	Other Wood	52838880	966216	736539	1.3939	9505	12064
21	Furn & Fix	38158056	224929	107795	0.2825	15768	3241
22	Paper&Alld	120516360	3530600	2772749	2.3007	199733	46394
23	Print&Publ	240838144	4238659	1493188	0.6200	103451	24950
24	Chem&Allid	255935504	2897579	621457	0.2428	166132	31196
25	Petrl Refn	328275360	2582505	700024	0.2132	37015	817
26	Rubber&Pls	110357072	2252758	1973859	1.7886	198529	33209
27	Leather Pr	7248647	127132	39190	0.5407	15745	1655
28	Glass,Ston	70760824	1553406	1294005	1.8287	87585	18217
29	Ferr Metal	70406080	248779	197855	0.2810	12135	2898
30	Prm Met NE	70029536	388855	259653	0.3708	35125	4084
31	Fab Met NE	164959120	3114046	2219983	1.3458	331461	34887
32	Computers	108836272	9650730	4227317	3.8841	2933996	98426
33	Oth Ofc Eq	5897480	49240	14056	0.2383	19048	486
34	Con Min Eq	32900258	698243	220439	0.6700	528728	84815
35	NonElc NEC	180954784	5300807	2616838	1.4461	1368843	62069
36	Elc Ind Ap	40733032	1344667	605986	1.4877	399353	14729
37	House Appl	19753958	360340	267191	1.3526	63014	4592
38	Comm Equip	96666656	599869	15310	0.0158	67332	4099
39	Elc Cmp NE	69672664	1079926	514559	0.7385	155752	9779
40	Misc Elc E	55928360	1342313	808864	1.4462	249031	15888
41	Motor Vehc	225392704	1041304	501029	0.2223	289856	12442
42	Oth Tran E	125351312	391690	209090	0.1665	97521	3419
43	Prof&Scn I	21175870	969821	451393	2.1316	327532	11181
44	Med Instrm	19307946	686424	292143	1.5131	94186	7114
45	Misc Instr	41640708	659348	261782	0.6287	229369	6813
46	Misc Manuf	50412032	1221478	893595	1.7726	90292	13347
47	Railrd Trn	43439344	1109619	491824	1.1322	83084	9923
48	Lcl Transp	18881920	466146	76266	0.4039	292	3748
49	Trck Wareh	114484248	1936757	495457	0.4328	45231	9859
50	Wtr & Pipe	52911336	424885	158003	0.2986	15774	674
51	Air Transp	110989776	2269240	1067433	0.9617	103534	719001
52	Trans Serv	16257543	222204	22556	0.1387	8623	0
53	Comm Servi	292632256	2685138	-0	-0.0000	29898	6608
54	Elec Utily	185884544	2528494	29	0.0000	850	13693
55	Gas Utilit	72635992	2127972	275246	0.3789	6588	13152
56	Watr & San	12831835	150529	0	0.0000	53	941
57	Whlsl Trad	594040384	10514649	1824587	0.3071	507157	57312
58	Eat&Drink	180484528	5384252	1315216	0.7287	1717	112216
59	Oth Retail	436890784	9439931	2124228	0.4862	0	246780
60	Bnk & Crdt	181154416	3769631	140085	0.0773	92605	20932
61	Insurance	164863552	3437447	360923	0.2189	8240	17130
62	Real Estat	718863040	14950158	1396824	0.1943	64647	88959
63	Htls Lodgn	115646184	1135567	108424	0.0938	412	21386
64	Per & Repr	122148344	3671862	710589	0.5817	163	78897
65	Bus Servic	544891200	4280055	251	0.0000	73221	40499
66	Prof Servc	130708624	2178220	1287299	0.9849	932	54286
67	Movies&Amu	87098064	683490	43433	0.0499	3031	12089
68	Hospitals	122977600	2864635	565177	0.4596	2654	72294
69	Medical NE	182221088	5696951	1642655	0.9015	35131	145053
70	Educ Servc	40307220	827512	118985	0.2952	325	20847
71	Oth Ser NE	67741184	1792820	514426	0.7594	862	45782
72	Fed Gov En	52949248	505811	20252	0.0382	3595	2549
73	S&L Gov En	49582892	630983	53913	0.1087	2473	4166
74	Scrap,Seco	0	0	0	0.0000	0	0
75	Gov Indust	395916512	7357000	-0	-0.0000	0	0
	TOTAL	9063558144	172717024	54792224		11292953	2620670.7500

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Figure 2.31

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TRANSPORTATION GROWTH RATES FROM 1992 TO 2000
EC 1992 Scenario

	YEAR 1992		YEAR 2000		ANNUAL GROWTH RATE	
	DOMESTIC EXPORTS (THOU $)	FOREIGN EXPORTS (THOU $)	DOMESTIC EXPORTS (THOU $)	FOREIGN EXPORTS (THOU $)	DOMESTIC EXPORTS %	FOREIGN EXPORTS %
RAIL	445,246	60,869	491,824	83,084	1.25	3.97
TRUCK	396,118	28,888	495,457	45,231	2.84	5.76
WATER/PIPELINE	137,543	12,285	158,003	15,774	1.75	3.17
AIR	817,533	72,965	1,067,433	103,534	3.39	4.47
SERVICES	14,530	6,872	22,556	8,623	5.65	2.88

Domestic and foreign imports by mode. Similar information can be obtained on domestic and foreign imports by transportation mode. This is shown below.

	Domestic Import ($000)	Foreign Import ($000)
Rail transportation	$45,445	$1,277
Truck transportation	293,823	*
Water/Pipeline	140,722	*
Air Transportation	289,397	36,597
Transportation Services	54,585	*

This table suggests that both air transportation and trucking play important roles in bringing domestic imports into the region. The lack of data on trucking, water, and service margins for foreign imports is due in part to the payment of these costs by foreign shippers and to the structure of the model. As a result of these data limitations, these findings may underestimate the value of transportation services and their accurate distribution by mode. These relationships can also be investigated in more detail as the trade model is applied to specific problems.

It appears that no major changes in transportation demand will occur with implementation of EC 92. However, there will continue to be growth across all transportation modes for both domestic and foreign shipments. The growth rates in purchases by transportation mode of Minnesota economy between the 1992 and 2000 time periods are shown in Figure 2.33. These show that growth in domestic rail is expected to be the lowest (1.25%), although rail for foreign shipments will have a relatively healthy growth (3.97%). Truck growth is expected to be approximately double that of rail. Growth in purchases of air transportation will be greater than that for trucking, domestically and slightly less than growth in trucking for foreign shipments. Water transportation is expected to see moderate growth. Purchases of transportation services are expected to increase significantly for domestic shipments and grow at half that rate for foreign exports. Further detailed analysis of model output would be needed to explain this behavior.

Reduced access to air transportation

Model assumptions. A preliminary assessment of the impact of aviation constraints on Minnesota can be made using air shipments to foreign destinations [See for example (Braslau and Maki, 1991). Information is available on those sectors which rely most heavily upon air transportation in the production of goods and services. These data can be extracted from the transactions table for Minnesota derived from the Minnesota IMPLAN model. It should be noted that these are not necessarily the industries that rely heavily upon air transportation for shipments to final demand or export. However, this does provide a simple basis for assessing the possible impact of loss in air shipments to foreign export.

Figure 3.32

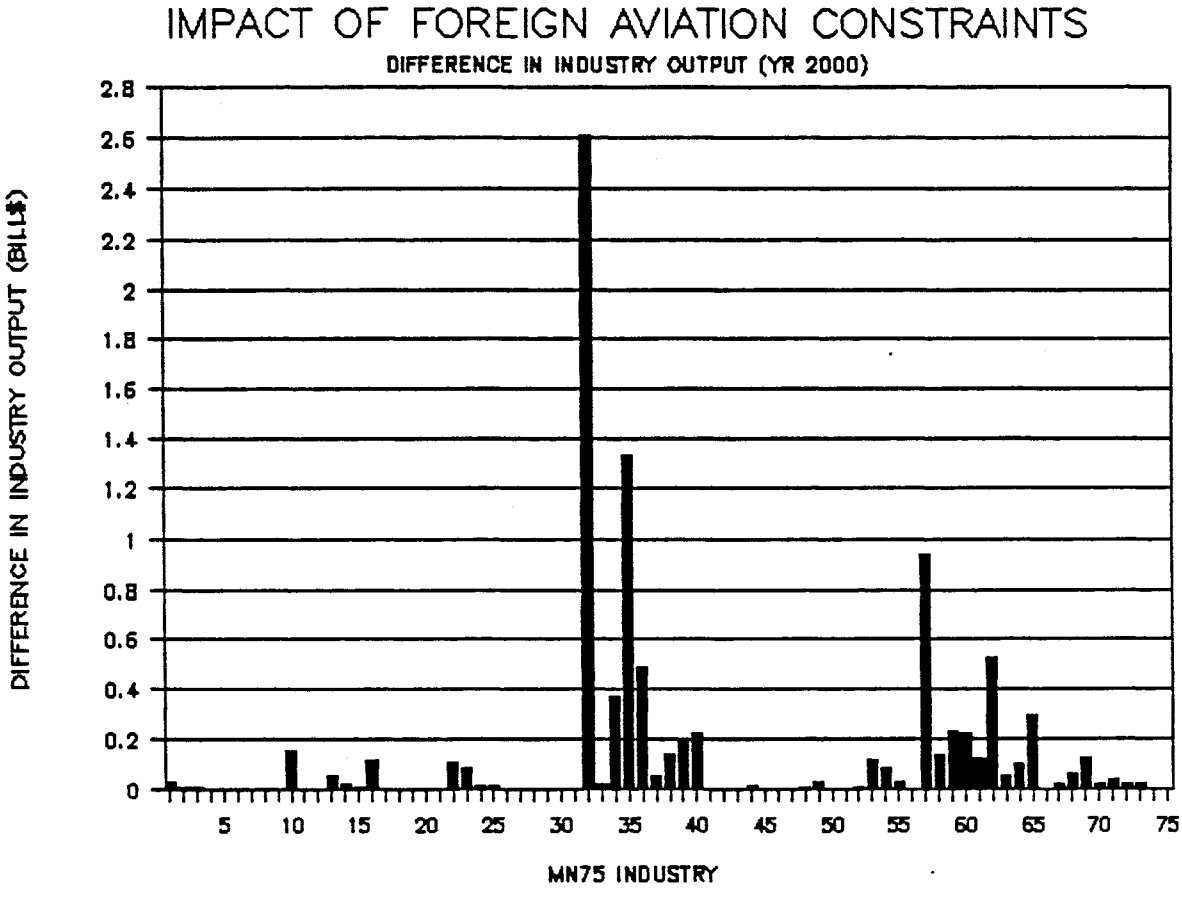
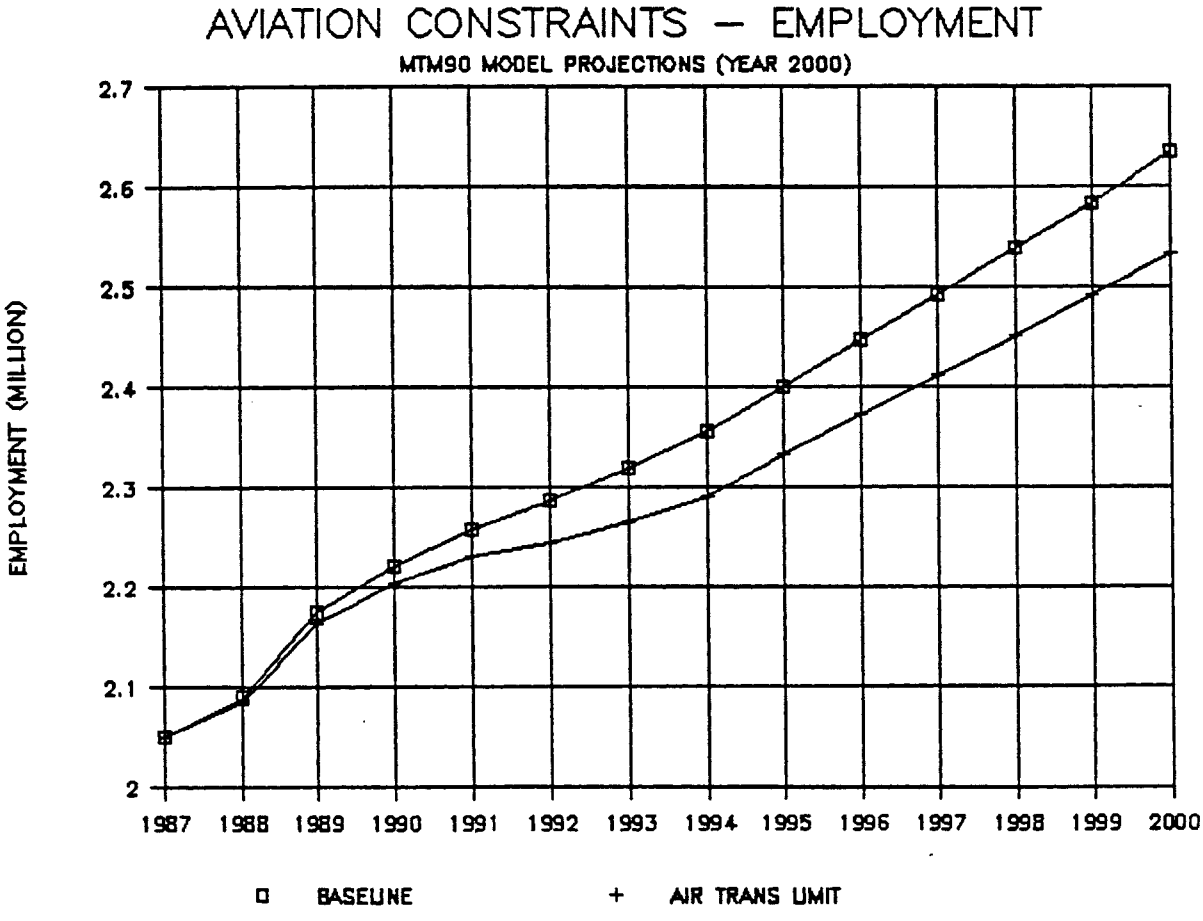

IMPACT OF FOREIGN AVIATION CONSTRAINTS
DIFFERENCE IN INDUSTRY OUTPUT (YR 2000)
DIFFERENCE IN INDUSTRY OUTPUT (BILL$)
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
MN75 INDUSTRY

Figure 3.33


AVIATION CONSTRAINTS — EMPLOYMENT
MTM90 MODEL PROJECTIONS (YEAR 2000)
EMPLOYMENT (MILLION)
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
BASELINE
AIR TRANS LIMIT

A realistic assessment of potential constraints on air transportation would require a comprehensive evaluation of air transportation capacity and the reaction of firms to potential capacity constraints. Even with limited airport capacity, shipments would be made to other points of departure (primarily Chicago) so that the overall impact would probably be less than that suggested here. The exact nature of this reduction would have to be determined in a more detailed study.

In this scenario, thirteen sectors (in durables, non-durables and services) that make large purchases of air transportation (as determined by the interindustry transactions table) have been assumed to be impacted. A 10% annual loss in market share (relative to other states) is assigned to these sectors and projections made of the Minnesota economy to the year 2000.

Projections under air transport constraints. Figure 2.34 shows the impacts on industry output when the foreign exports of aviation using industries are constrained. Impacts are negligible for most durable and non-durable industries except for high technology equipment that relies more heavily upon air transportation.

Figure 2.35 shows the impact over time of aviation constraints on Minnesota employment and suggests that approximately 100,000 jobs could be lost by the year 2000 with reduced foreign exports in only those sectors that rely upon air transportation for intermediate purchases.

The probability that Minneapolis-St. Paul would suffer a 10% annual loss in foreign market share in air transport shipments is very low as long as at least some air service is provided to these destinations. Also trucking these goods to Chicago is a realistic alternative for many of the products which are currently shipped to foreign destinations. In fact, such trucking currently plays a significant role in the region's exports. Therefore, the estimated impacts from air transportation constraints may be too high. This annual reduction is applied only to *foreign* exports -- these account for only 15% of total air shipments out of the state. Therefore, if reductions in *foreign* and *domestic* exports occur due to constraints on air transportation, significant impacts on the state's economy could occur. Before an assessment of this can be made however, a careful study of how such constraints might affect shipments must be made.

With restricted access to air transportation for domestic exports, trucking products to Chicago for air shipment could be a larger share of the cost and could in the long run cause relocation of firms to locations with better air service. To more accurately assess the impact of aviation constraints on the Minnesota economy, the response of manufacturers and business to such constraints will have to be determined. The response of firms to transportation investment as well as to transportation constraints is a long-term objective of the study of Transportation and the Economy of the Upper Midwest. The findings of a survey and focus groups of Minnesota carriers and selected shippers is presented in the next section of this paper.

3. INDUSTRY DETERMINANTS OF THE CHANGING DEMAND FOR TRANSPORTATION

Recent Trends in Public/Private Transportation

During the past twenty years, large and small producers, across most industries have changed their production and distribution methods. These changes have led to new demands in transportation. Among the industry changes are:

- integration and consolidation of shippers, carriers, and intermodal terminals.
- increased "Just-in-Time" shipping;
- increased intermodal approach to shipping;
- shift to customer service orientation;
- increased use of technologies to improve logistics and transport productivity.

Integration, consolidation and outsourcing. Transportation and delivery functions are no longer separate from the production side of any business, whether it is agricultural, manufacturing or retail. Companies respond to the pressures of global competition and customer requirements by rethinking their operations. Customer service, inventory control and cost management are the driving forces. This move toward greater integration and consolidation is apparent in five major changes: 1) integration of internal corporate functions, 2) consolidation of producers physical plant, 3) reduction in the number of carriers used, 4) increasing integration of relationships between shippers and carriers, and 5) increasing use of transportation services to manage product delivery.

Traffic management has moved beyond the clerk sitting in a warehouse making decisions about routing the day's shipments; it is evolving into a new corporate logistics and planning function that directly impacts corporate policy. Changes at Land O' Lakes illustrate this integration (Traffic World, 1988:2). Prior to 1977, the company's transportation and distribution activities were conducted within autonomous product divisions. In July 1977, the company combined its warehousing and transportation functions into a single operating division.

As part of the integration of services, companies are also consolidating their shipments and reducing their carriers. This movement is referred to as the Preferred Carrier or Carrier-Reduction plans. Some shippers who in 1989 dealt with more than 100 motor carriers now use just three or four. A study conducted in 1989, predicted that the number of carriers regularly used by the average shipper would drop from 80 in 1987 to 60 by 1990 and to less than 50 by 1995 (Macdonald, 1990).

These closer relationships with fewer carriers are leading to greater integration between shippers and carriers. The benefits to shippers are twofold: service is improved and costs are reduced. The 3M Company is one of the leaders in developing partnerships with carriers through their Total Quality process. As 3M strengthened its partnerships with individual carriers, the

number of truck load carriers decreased from 284 in 1984 to four in 1992, and its number of intermodal management companies decreased from seven to two (Macdonald, 1992:2).

Traffic functions are being integrated into company management and are no longer relegated to the back dock door of the company. Smart companies now view logistics as a staff function, covering everything from raw material forecasts and procurement, through order processing and invoicing, to new product development. The goal is to reduce cycle time. Warehousing is minimal -- the only inventory is that which is on the floor of the manufacturing area, especially for larger companies. The next logical step is the use of a third party logistics company to manage the flow from the vendor to the customer. This may expand to include a logistics company who operates the warehouse, stocks it, ships parts, and operates a pick/pack operation according to the shippers' standards and requirements.

Another new approach to transportation management is to "outsource" traffic services. An example of outsourcing is Pillsbury's contract with the C. H. Robinson Company to handle its shipments (Richardson, 1992). This arrangement has led to hassle-free delivery of product to customers, consistent service, competitive pricing and stable staffing, as well as knowledge of market trends beyond the food industry.

Just-In-Time (JIT). Changes in market conditions have led to the expanded use of just-in-time (JIT) delivery. The preferred modes for JIT delivery are LTL (less than truckload) trucking services or express-air services. This trend began in 1983 when the number of express air shipments were pegged at 10.8 million. This number tripled by the year 1986 and continues to grow (Callari, 1988). At the same time, rates have dropped in the air freight industry due to the excess capacity available in both the domestic and international air cargo lanes.

Companies are implementing new measures to reduce their order-cycle times. This allows them to effectively reduce inventories. Today's inventory investment nationwide is $200 billion below what it was in 1981, a recession period. Typical order-cycle times have declined from 5 days in 1988 to 4.5 days in 1991, and are forecast to decline to 2.9 days in 1995 (Cass Logistics, 1992). Companies now ship directly from their vendors' warehouses to the job site if a replacement part is required, thus bypassing the central warehousing facility at their manufacturing plant. It reduces time, energy and money spent to get the part from the source directly to the customer.

Nationally shippers are beginning to ask for "Exactly on Time" (XOT) deliveries. Sears Logistics Service Director states, "XOT differs significantly from Just in Time deliveries. It requires much greater discipline" (Comerford, 1992). Sears, for example, has established arrival windows of 15 minutes for both pick up and delivery of product. XOT is handled primarily by truckload carriers. XOT is not in the terminology of shippers responding to the authors' survey, but the desire for similar performance and delivery is.

Intermodal. Intermodal shipments have doubled since 1981 (Harper, 1991). The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) conveys a public commitment to

intermodal transportation. Complementing public efforts are the private efforts of the Intermodal Marketing Association (IMA). The IMA is urging railroads to adopt the Transportation Data Coordinating Committee's (TDCC) data-interchange format standards for motor carriers, which IMA members use with their shipper customers. Most shippers' computerized bill-of-lading systems are geared toward motor-carrier transportation (Quinn, 1988).

During the past ten years, former railroad personnel have formed service and marketing companies to respond to the shippers desire for a seamless approach to transportation. These third parties go beyond what any one transportation vendor could provide. Rather than invest in equipment, warehouses, or transportation equipment, they typically invest in personnel and data management systems to provide the service their customers require.

Railroads who have established third party companies as subsidiaries include the Union Pacific, Conrail and the Sante Fe (Macdonald, 1989). Within Minnesota, rail carriers such as the CP/Soo Line and the Burlington Northern have not formed third party subsidiaries, but instead consider third party companies as their customers.

Technology Investments. Capturing data on a computer to improve customer service was initiated in the railroad industry in the early 1960s. Rail lines were among the first to recognize the useful applications of computer tracing, tracking and billing of shipments. They now have systems to allow their customers to install software in the shipper's data base. For example, a shipper may dial into the Burlington Northern system and transmit rail billing or request updates on the location of their shipments at any time. The CP Rail (as parent company of the Soo Line) is developing a similar system, but their current interactive system is limited to railroad to railroad interchange information. These types of systems are used by shippers, third parties and intermodal operations of steamship lines. Unfortunately, systems are developed independently and are often incompatible with each other.

Current and Future Outlook of Selected Industries

Research Methodology. A telephone survey of 54 firms and several focus groups were designed to test the projections and implications of the economic models and to ascertain the private sector's changing transportation demands. To supplement these, a literature review identified recent trends in the transportation industry. The survey focused on four major industries in the Upper Midwest: Grain (food and feed), Printed Matter, Computers, and Transportation Equipment. These industries were selected according to the following criteria: 1) major industry in the region; 2) industry with significant transportation purchases and exports from the region; and 3) sector with sufficient number of firms to maintain confidentiality.

Using business directories, 15 to 20 of the largest firms in each industry group were identified. Next, using trade association lists and the *Corporate Report Fact Book*, the logistics manager for each firm was identified, provided with a copy of the survey and scheduled for an interview. During April, May and June 1992, responses were received from 54 firms. These firms represent a major share of shipments within and outside the state and use a variety of transport modes. (Figure 3.1) Two focus groups were conducted. The first included representatives of a range of modes and types of carriers[5]. The second focus group included representatives of the printing and publishing industry and the grain elevators' association.

The phone survey of shippers focused on current and future product and material distribution, use of various modes, warehousing, just-in-time practices, and infrastructure investments. Respondents were asked to identify regulatory and other barriers to shipping, the extent to which the current transportation infrastructure meets their needs, and to suggest public policy recommendations. Figures 3.1 and 3.2 summarize the data collected from the survey respondents. Figures 3.3 and 3.4 show data and projections for these four industries using various economic models. The following sections summarize the findings of the firm survey and subsequent focus groups.

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[5]Participants in the carrier's focus group included third-party consolidators, air cargo, steam ship line, warehouse, small package freight, as well as the Minnesota Trucking Association, the Minnesota Transportation Regulation Board and the Upper Mississippi Waterway Association.

Figure 3.1

Surveyed Firms' Share of Total 1990 Export Shipments

	SURVEYED FIRMS		TOTAL INDUSTRY	Firms'
	No. Reporting	1991 Reported Shipments (mil. lbs.)	1990 Exports (mil. lbs.)	Share of 1990 Total
Grain	16	9,503	30,903	30.7%
Printed Matter	11	639	1,535	41.6%
Computers	18	15	205	7.6%
Transp. Equip.	8	764	767	99.6%
Total	53	10,921	33,410	32.6%

Source: Firms Survey and 1988 Reebie data as modified by BLS projections for 1990.

State and Local Policy Program
Campbell, Petersen, Van Hattum
8-12-92

Figure 3.2

Destination of Surveyed Firms' Shipments (by Percent of Total)

	DOMESTIC				FOREIGN				
	Total Shipments (mil. lbs.)	Minne-sota	Upper Midwest	Rest of U.S.	Total	Canada	Mexico	Rest of World	Total Foreign
Grain (15)	5003*	51.3	15.8	20.3	87.4	1.2	0.6	10.9	12.7
Printed Matter (11)	693	28.6	16.3	53.9	98.8	0.9	0.0	0.2	1.1
Computers (18)	15	10.0	13.8	54.1	77.9	2.2	1.4	18.5	22.1
Transportation Equipment (8)	764	1.2	10.7	62.9	74.8	8.2	1.0	16.1	25.3

Numbers in parentheses are number of firms reporting figures.
*Does not include shipments from surveyed firms not reporting detailed destinations

State and Local Policy Program
Campbell, Petersen, Van Hattum
8-12-92

Figure 3.3

Output and Exports of Selected Minnesota Industries

Output and Exports 1990 (billions of dollars)

	Total Output	Regional Consumption	Domestic Exports	Foreign Shipments	Total Exports	Percent Exported
Food and Feed Grain	5.918	1.713	2.715	1.489	4.205	71%
Printed Matter	4.330	2.823	1.397	0.111	1.507	35%
Computers	6.016	1.755	2.665	1.596	4.261	71%
Transportation Equipment	1.588	0.386	0.803	0.398	1.201	76%

Source: Minnesota Trade Model, Regional Econometrics, Inc.

State and Local Policy Program
Campbell, Petersen, Van Hattum
8-12-92

Figure 3.4

Shipments from Minnesota, Selected Industries

Shipments from Minnesota, Selected Industries, Estimates for 1990 and 2000 (thousands of tons)

	1990	2000	Pct. Change
Food and Feed Grain	15,454	24,670	59.6
Printed Matter	299	563	88.3
Computers	103	195	89.3
Transportation Equipment	384	455	18.5

Source: 1988 Reebie Data, modified by Bureau of Labor Statistics (BLS) industry projections.

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8-12-92

Grain

Size, Origin and Destination of Shipments. Products shipped by the grain producers interviewed included edible sunflowers (both in hull and kernel), barley, oats, bird feed, hulled millet, soybeans, spring wheat flour, durham semolina, corn and flax. Outbound shipments of the 16 firms reporting totalled 6,399 million pounds in 1991. Foreign export volume shipped by these firms ranged from 0 to 90 percent of their shipments. Shipments ranged from 12 to 750 million pounds per firm.

For most domestic shipments, grain is typically brought to a consolidation point by owner-operated trucks and then shipped by rail to the buyer. For export, grain is shipped containerized via rail to the port of loading. The primary exit port is Montreal, Canada. Based on the phone interviews, the industry uses rail to deliver grain when the following three conditions exist: 1) The destination is greater than 250 miles from the origin point, 2) Rail cars are available at the consolidation point or grain elevator, and 3) Shipments are delivered to ports of loading for foreign and domestic destinations. Grain shippers prefer to use rail, however they mentioned two drawbacks to using short-line rail connections in rural areas: 1) historically unreliable scheduling and 2) the high cost of interlining with major railroads.

Current and Future Market Conditions and Barriers. Shippers of grain must weigh the cost and service differences between rail, truck, and water shipment. Competitive rates and service of truck carriers have cut into rail tonnage significantly. For grain shippers, there seems to be a significant trade-off between time and price for these shippers. Grains are low value and high volume, forcing the shipper to demand low cost transportation. Grain shippers are not alone in identifying truck as the most reliable mode to deliver their products, yet they will choose rail whenever possible to save money.

The total tonnage moving by rail increased by 3.9 percent nationwide between November 1991 and June 1992 (*Traffic World*, 1992). The volume of grain shipped for the 26-week period ending 6/27/92 as compared to the same period in 1991 was down by 19.8 percent. This seems to be part of a larger trend; total carloads shipped for the week ending 6/27/92 fell 17.7 percent from the same week in 6/27/91. This could reflect either a downfall in the national harvest or a lack of competitiveness by the region.

The grain shippers interviewed predicted a number of impending changes, including:

- Consolidation of grain elevators resulting in fewer rural elevators, and jobs
- Increased use of piggyback delivery due to lower cost pricing
- Buy out of short-line railroads by local grain elevators as larger railroads divest themselves of short-lines or as independent owners face financial difficulty

Transportation constraints cited by industry representatives include:

- Interstate trucking regulations governing pricing by commodity and regulations for transloading of edible products
- Weight limits on secondary roads
- Difficulty obtaining trucks and containers in North Dakota due to one-way hauls or deadheading
- Lack of rail capacity and equipment during peak seasons
- Grain elevators without scales to weigh rail cars prior to departure which result in fines for carriers.

Barge transport of grain faces competition from other mode as well as from land use regulations. Capacity-enhancing investments in locks and dams are being weighed against the desire of urban dwellers to designate rivers as natural or recreation areas.

The grain industry in the Upper Midwest faces economic competition from other regions or producers. Much of this disadvantage is due to the producers' remote locations, often far from a mainline railroad. The grain industry also faces a great deal of uncertainty regarding to impacts of EC'92, GATT and NAFTA on international tariffs and foreign competition.

Warehousing, Just-in-time, Technology and Other Investments. Since few grains are sold directly to manufacturing companies, grain elevators or brokers generally do not use a "Just in Time" schedule with their customers. Only when grains are partially processed are they sold directly to a manufacturer. In such cases, "Just in Time" scheduling significantly affects grain elevator's transportation selection and planning. The focus becomes transportation service before price, because deliveries are tightly scheduled around the manufacturers' requirements. When the shipments are scheduled for delivery to a manufacturer's plant, they rely on long haul truckers to deliver the product.

Grain shippers use Electronic Data Interchange (EDI) to varying degrees. For some the use is extensive, for others it is a small part of their daily transactions with their vendors, including the railroads. Grain shippers anticipate EDI transactions will increase in the future.

Grain producers believe the Upper Midwest provides a geographic advantage because of the variety of transportation modes available. By investing in hopper cars, storage facilities and truck fleets, grain elevator associations in the region are positioning themselves to capture a greater share of the market.

Grain elevators in the region are predicting they will continue to consolidate to obtain economies of scale and to remain competitive in the national and international marketplace. The

associations have contingency plans in place to purchase short-line railroads to assure product delivery to market.

Printed Matter

Size, Origin and Destination of Shipments. Products shipped include forms, books, publications, catalogues and advertising. These products are shipped primarily to domestic buyers outside of the region. Annual shipments by weight for the firms surveyed range from 2.3 to 546 million pounds. The total amount shipped by the 13 firms surveyed was 730 million pounds.

Current and Future Market Conditions and Barriers. Key factors in the publication and printing industry are timeliness of the delivery and the integrity of the product. Transportation is integrated into the production cycle, and production is scheduled around the transit time from the printing facility to the customer's door.

All of the respondents indicated they use two or more modes to handle their deliveries, but each carrier operates independently from the other. Coordination comes from the traffic department at the shipper's facility or from the forwarder who arranges either the domestic or international shipment.

Rail service is used to deliver paper rolls, not finished product. The trucking industry is the primary delivering mode as a result of its reliability, speed and flexibility. Air freight services, such as Federal Express, Air Express or UPS are increasingly used. However, shippers predict air freight delivery will become the norm if the spot market rates remain competitive with LTL rates and service. Shippers are willing to pay the premium for an expedited delivery, if their cost is less than the premium paid by the buyers.

Two important spatial considerations were mentioned by respondents in this sector. First, newspaper publishers commented that they would like to be located within 100 miles of a paper plant. Secondly, the marketplace for producers of printed matter is usually regional (within 250-500 miles from their production plants). Advertising and other specialty producers serve national markets and receive material inputs, even paper, from across the U.S.

Shippers in the printing industry are seeking greater investment and commitment from carriers. Carriers are being sought out who provide on-schedule service, product warehousing, tracing, tracking and billing electronically (EDI), and automatic labeling with bar coding. These new demands of survey respondents are confirmed by a national reports of shippers seeking faster transit times, multiple pick-ups, and special deliveries (Cooke, 1990).

Warehousing, Just-in-time, Technology and Other Investments. A transportation priority for this sector is delivery to the customer on a "Just In Time" basis without damage. Printing companies warehouse product at the request of their customers. As a result, printing companies are shipping in smaller lots sizes of 50 to 100 pounds. The preferred modes are LTL Trucking Services or Express Air Services.

Technological advancements have had an important impact on the printing industry, changing their product shipments from heavy loads of product to computer disks. In some cases, product is literally "shipped" via telecommunications networks. This substitution is predicted to increase significantly in the future.

Computer Industry

Size, Origin and Destination of Shipments. The computer products shipped by survey respondents include finished computers (personal, mini, mainframe and supercomputers), electrical connectors, back panels, communications processors, computer boards and disk drives. The total shipped by these 18 firms in 1990 from Minnesota was 11 million pounds. As evidenced by the share of the total market represented by the survey respondents in Figure 3.1 is low. Unlike the other industries many smaller producers are prevalent.

The computer industry is fluid and subject to frequent market changes and product innovation across state and national boundaries. Product type and sizes are changing. Personal computers are mass produced, while supercomputers are custom designed. Personal computers are smaller and lighter and require responsive delivery to customer demands, while supercomputers are bulky, and shipped infrequently.

Current and Future Market Conditions and Barriers. Two trends occurring industry wide are downsizing and consolidation of plant and shipments. Downsizing is a result of increased competition between companies and company buy outs. Companies are consolidating their shipments to one site in response to customer access, facility cost, labor cost and availability of transportation.

According to industry observers, the developing high-tech corridors are in California, the Eastern Seaboard and Texas. Although Minnesota has major computer companies like IBM, UNISYS, Cray Research, among others, that produce supercomputers, mini and mainframe and personal computers, a corridor like that of Silicon Valley has not developed here. The increased quantities of mass produced computers in this region is unlikely. In fact the market for mainframes such as those produced in this region, is expected to remain relatively flat. According to Mr. James Unruh, CEO of UNISYS, "The growth will come from services, software and servers" (McGough, 1992).

The pressure facing this industry is illustrated in the experience of one of those surveyed. This company had utilized a Mexican assembly facility, but found the facility inefficient and the costs higher than expected. They found that the problems they encountered were easier to control at facilities in the U.S. As a result, they developed a distributorship in Mexico to whom they sold the finished product.

Warehousing, Just-in-time, Technology and Other Investments. Suppliers control the routing of materials. Companies who ship as little as 300,000 pounds of cargo per year weigh the advantages and disadvantages of routing the cargo from their vendors' facilities. Routing control

gives computer companies additional volume to use at the negotiating table with their transportation vendors which in turn work to control delivery costs to the manufacturing site. Companies plan their inbound and outbound shipments well in advance in order to reduce transportation as a factor in their manufacturing cycle. Typically, the larger the buyer the more likely they are to control routings to and from their facilities.

Computer companies demand on-line computer systems with their carriers. Carriers such as Federal Express, United Parcel Service (UPS) and Airborne Express have integrated their systems by offering ground transportation, air freight, data exchange, warehousing, and bar code labeling.

Computer manufacturers who have larger units are unable to obtain daily air freight service direct from Minnesota to all their shipping destinations. As a result, they truck their cargo to Chicago where air carriers offer regularly scheduled flights with the capacity to handle oversized cargo.

Rail service is only used for larger volume shipments of parts required in the mass production of personal computers. In this case, rail is a part of an intermodal delivery arranged by carriers from port of origin to the warehouse, combining vessel, rail and truck under one bill of lading. Although importers will use ocean service to move the parts inbound, exporters rely exclusively on air freight. Domestically and internationally, the computer industry seeks tighter shipment control, better inventory management and cost savings.

Computer companies responding to the survey suggested increased investment in the road system to reduce maintenance and decrease the number of detours. There is discussion within this industry about the drawbacks of intrastate tariffs and the rules governing those tariffs. Companies rely on trucks to deliver parts from other manufacturers in the state. According to these companies, suppliers in surrounding states have a competitive advantage to local suppliers for this reason. Respondents were also concerned about the impact of noise control at the airport and the detrimental effect it will have on airline schedules. Finally, respondents believe that a bullet train or high speed train corridor to Chicago would be advantageous due to their high volume of small, valuable shipments.

Transportation Equipment

Size, Origin and Destination of Shipments. There is a wide range of commodities in the industrial classification of transportation equipment. These include tractor cabs, automobiles, trucks, truck shields and visors, automotive tools, forklifts, air filters, trailers and railway cars and parts. The total amount shipped by the 8 firms surveyed was 760 million pounds.

Current and Future Market Conditions and Barriers. Rail has diminished in importance to this industry as reliance on trucking has increased. It is believed that truck carriers will take an increased share of the volume in the future. Railroads will retain their market, or

regain market share lost to the trucking industry, but only if they are able to provide: reduced transit times, reliable schedules, and maintain competitive rates.

According to *Traffic World,* approximately 63 percent of manufactured motor vehicles moved by rail in 1990, and these are a big revenue item for carriers (*Traffic World,* 1992:1). The Norfolk Southerns' W. J. Certer Jr. stated that 15.6 percent of the railroad's merchandise traffic revenue is auto and auto parts . Railroads are seeking rate exemptions for auto parts and autos from the Interstate Commerce Commission (ICC) under the Staggers Act.

Warehousing, Just-in-time, Technology and Other Investments. Just-in-Time is integrated into this industry domestically and internationally. The supplier often has a specific window of opportunity for delivery. There is reliance on day to day delivery and scheduled delivery of parts. Warehousing is kept at a minimum, parts are in supply only to keep manufacturing in place. Damage free transport is very important to this sector, when claims can be avoided, it saves paper work, repair costs, delays in delivery due to rework, lost customers and additional handling costs.

Carriers are proactive and becoming a part of the day to day business cycle of these manufacturers. They are offering increased communications, scheduled deliveries and pick ups, and equipment movement. Nationally, the transportation equipment industry is significantly reducing the number of carriers used. In fact, the Ford Company in Southern California sought out a partnership with a single vendor who was willing to offer night time delivery to their dealerships in 1986. By 1990, 95 percent of Ford's Southern California dealers were being served at night (Cooke, 1990).

According to our survey respondents, a goal of the producers of transportation equipment is to reduce the number of carriers by 20 or 30 percent if the volume is extremely high, or in low-volume cases reduction to 1 or 2 key carriers is sought. Frequency and size of shipment are inversely related. The smaller the size of the shipment, the more frequent the shipments. Small package services and fleet shipments allow the truck to drop orders and pick up supplies for manufacturing. These were mentioned as alternatives to current practice of the weekly "Trailer Load" shipments.

The North American Free Trade Agreement (NAFTA) should have important consequences for this sector. A recent article in *Traffic Management* described the barriers to increasing trade expected from signing of NAFTA (Gooley, 1991). It suggested that supply and distribution occurs with relative ease between automotive plants and distribution centers in Canada, the U. S. and Mexico. However, these companies recommend standardizing trucking regulations in the U. S., Mexico and Canada to allow the free flow of goods. Presently, every load must be handed from the U. S. carrier to a subcontractor of Mexican ownership at the border. Truckers face significant delays in crossing the border due to customs inefficiency, corruption, and inconsistent application of regulations. Survey and focus group participants echoed much of this experience. They also suggested that the present infrastructure has an insufficient number of border crossings and customs officials to clear the truck loads.

At this point, rail has an advantage over truck for movement of these goods because the cargo moves under U. S. Customs Bond from U. S. origin to the interior Mexican destination. The Mexican government is eager to develop rail networks and is signing joint operating agreements with U. S. railroad and intermodal operators. One rail service, American President Lines, has been so successful that it is examining the potential of including Toronto, Montreal, and cities in the northwestern U. S., as well as the port of Los Angeles in their U. S. - Mexico network (Gooley, 1991). Survey respondents confirmed that if rail can meet their requirements of service and reliability, shippers will use them first. This is especially true if reliable intermodal options are available.

Manufacturers who rely heavily on suppliers in Minnesota bemoan present trucking regulations which require carriers to wait 10 days prior to establishing a rate for shipments. This setup does not accommodate urgent shipments, and forces the shipper to use a vendor who has a rate filed; but may not be involved in the shipper's transportation program. A program which provides electronic billing, bar code labels and prompt updates on shipment delivery scheduling is desired. One respondent objected to the intrastate regulations which operate in 31 states and prevent a company truck fleet to carry goods for companies other than themselves, including affiliated companies.

Summary of Findings and Recommendations

The transportation industry is undergoing significant changes nationally and within the Upper Midwest region. Major shift include: 1) greater use of trucking and a move to intermodal and multi-modal service, 2) increasing use of new data and communications technologies to manage shipments from supplier to producer to market, 3) acceptable delivery times are shortening resulting in growing use of air freight and increasing substitution of electronic media and telecommunications for delivery in printing and publishing industry.

Attempts are being made to reduce the transportation costs of production. These impact both the size and location of shippers, their corporate structures and relationships with carriers and their investments in technologies to improve logistics and transport productivity. The demands of time and efficiency are leading to just-in-time transportation, increased intermodal shipments, reductions in the number of carriers used and increased use of third party carriers. New technologies and facilities which enable cargo containerization as well as new rail car designs and EDI systems are making rail more competitive with truck. However, rail is predominately used for hauling to destinations of greater than 250 miles when time of delivery is not a major priority.

From analysis of the economic data, we selected four industries to survey regarding implications of the economic models. Questions focused on current and future product and material distribution, use of various modes, warehousing, just-in-time practices, and infrastructure investments. Respondents were asked to identify regulatory and other barriers to shipping, the extent to which the current transportation infrastructure meets their needs, and to suggest public policy recommendations. These industries are Grain, Printed Matter, Computers and Transportation Equipment. 54 firms were interviewed during a three month period in Spring of

1992. While not entirely representative of the total industry in the region, the comments were insightful. In addition, two focus groups with representatives of two of the four industries and an array of carriers were conducted.

In general, the companies surveyed were very satisfied with Minnesota's transportation system. In many respects, perhaps because respondents were logistics managers rather than company CEOs, these shippers and the carriers took a short-term view. Their recommendations were almost exclusively targeted at reducing regulations rather than improving the transportation system now in place.

Grain. Grains, both feed and food grains, are among the largest export commodity from the state of Minnesota. According to the Minnesota Trade Model destination of grain shipments are 29% within the region, 46% to the rest of the U.S. and 25 % to foreign lands. Much of the foreign shipments are by rail to Montreal. However, there is significant grain shipment by both truck and rail. Most grain shippers suggest that 150 miles is the breakpoint within which they will use truck transport.

The production and distribution of grain is changing the rural landscape. There is a great deal of consolidation to new elevators in order to take advantage of lower cost unit trains. This consolidation has lead to increased use of owner-operated fleet and public and private purchase of short-line rail. Producers believe that the future may bring about increased value-added processing in the state such as ethanol production making the industry somewhat more competitive.

Key barriers in the transport of grain included the lack of equipment during peak seasons, difficulty getting containers in remote locations due to deadheading, and weight limits on secondary roads.

Printed Matter. These commodities include specialty advertising as well as books and other publications. Minnesota has a concentration of these producers in large part due to the historical availability of paper products. Several major national firms such as Deluxe Checks, a direct-mail house such as Fingerhut, and a law book publisher such as West Publishing are located here. Inbound shipments in this industry come by truck and rail. Outbound shipments are by truck and air. This industry really has two markets -- a national market for specialty advertising and products and a regional market -- from various publications. Of the four industries surveyed Printed Matter has the smallest exports from the region. Shipments are 65% in the region, 32% to the rest of the U.S. and 2.6 percent to foreign destinations.

These is significant use of LTL and air express services in this industry. In the future they expect to decrease their demand for transportation and increase use os electronic media and transport by telecommunications. Publishers of newspapers commented that they like to be within 100 miles of a papers plant, however, it is interesting to note that despite the availability of paper products in the region there is significant importing of paper product from across the nation as inputs to production for the specialty advertisers. This industry is clearly one that needs to have

timely delivery of product. The availability of air cargo service and telecommunications capability will drive the future competitiveness of these producers.

Computers. Products vary from parts and peripherals to personal computers, minicomputers, mainframes and supercomputers. This industry is dominated by smaller companies however several major firms including IBM, UNISYS and Cray Research are located here. Computers are also among our largest exports by dollar volume. 29% stay in the region, 44% go to the rest of the U.S. and 26 percent to foreign destinations. Air transport dominates their shipments both domestically and internationally. However as much as one-third of the international exports by air go out of Chicago rather than Minneapolis. In-bound shipments of mass produced parts come by container from international origins.

Survey respondents mentioned lack of air service as a current and future barrier due to scheduling, destinations, and capability to handle over-size cargo. Through the focus groups we learned that printed matter and computers are the largest shippers by air freight from Minneapolis-St. Paul. Shipments by our major domestic carrier have gone down during the past year due to the business cycle but also due to the loss in market share which was lost during the Gulf War to other national air cargo carriers such as Japan Air. Companies interviewed were concerned about potential reductions in air service due to noise regulations. They also suggested they were interested in the potential of high-speed rail to Chicago. Within the state, these producers offered that tariffs charged by the state on shipments by suppliers make them uncompetitive to suppliers located in surrounding states.

Transportation Equipment. These commodities include trucks, automobiles, fork lifts, automotive tools, air filters and railway cars and parts. This industry has made a significant shift from rail transport to truck. Nationally the automotive industry is a major profit center for railroads. Increased use of EDI and intermodal facilities by railroad may stem this shift. This shift is in large part due to the widespread use of Just-In-Time manufacturing that requires daily delivery of parts and supplies. Because of this requirement, producers in this industry suggest revamping state laws regulating intrastate shipments. Currently, carriers are limited to areas in which a rate has been filed and must wait 10 days to establish a rate for shipments which are urgent for the customer. This industry is heavily invested in EDI Electronic Data Interchange systems from their suppliers to their customers. From Minnesota, 24% of shipments are within the region, 50% go to the rest of the U.S. and 26% go to foreign destinations (one-third of which is to Canada).

The Carrier's View. Our focus group with carriers was unique. For most of the participants it was the first time they had ever sat around the same table to discuss transportation issues and needs. They were especially grateful to the University for organizing such an opportunity. We learned that Chicago rather than other local carriers is the region's competition. This is especially true for trucking but also true for air shipments. Participants remarked that the trucking industry domiciled in the region is shrinking with fewer numbers of large carriers. In addition they confirmed that trucking firms are relocating to surrounding states due to regulations which make it uncompetitive to operate as a Minnesota firm. They did not believe that in the long

run, Minnesota would suffer a loss in service due to the restructuring and relocation but it would suffer less competitive pricing. One participant remarked that in the case of one troubled firm, the Minnesota bankruptcy judge ordered the firm to relocate in an adjacent state in order to make more money.

Recommendations regarding the trucking industry also centered around standardization of trucking regulations and paperwork in the region to better accommodate interstate shipments to and through the region. There was some discussion of international trade. For rail, it is uncompetitive because of the one-way trips -- there currently is nor enough product to ship back from that region to make it profitable. They are hopeful that NAFTA will increase goods production there.

Adoption of intermodal shipping is slower in this region, but carriers have seen a great deal of change in the past 5 years. One key problem facing a number of modes in the region is the siting of intermodal facilities. In particular, the waterways are fighting forces that want to change land uses along the river to park and recreation uses. Rail-truck facilities are also under increasing pressure to relocate from surrounding residential neighborhoods. The waterways are also interested in gaining competitiveness by increasing their lock and dam capacity but recognize the difficulty in obtaining public financing for such improvements.

4. SPATIAL ECONOMIC DETERMINANTS

Classifying Spatial and Economic Determinants

Overcoming the economic, social and political costs of space prudently and productively with the greatest net benefit to state and regional residents is the constant challenge of state and regional transportation systems planning and policy. Each of the state governments in the Upper Midwest has overall jurisdiction for transportation policy and planning within its territorial boundaries. In order to plan transportation systems it is necessary to understand the economic and spatial determinants of functional areas within each state.

Labor market areas (LMAs). In this study, the local labor market and its commuting area is the functional territorial unit for the study of local structural change. The local labor market areas of the Upper Midwest delineated in Figure 4.1 extend beyond the six state boundaries into the 12-state Northern Transportation Corridor. Individual LMAs are defined by the commuting behavior of individual county residents.[6] Area boundaries mark the counties with approximately the same numbers of residents commuting to adjacent local labor markets, according to the 1980 US Census of Population reports for the individual states.

Each labor market area is classified according to:

1) the size of its export-producing and residentiary sectors, and
2) its function as a metropolitan core, transitional or peripheral area.

Export-producing industries. The export-producing industries account for much of the economic base of the local labor market area. Income payments from prior investments of local residents or transfer payments from public and private sources outside the area account for the remainder of the local economic base. The export-producing sector of local industries brings "new" dollars into the area. This sector includes industry groups such as agriculture, mining, construction, manufacturing, transportation, communications and public utilities, retail and wholesale trade, finance, insurance and real and estate, hotels and lodging, personal services (for visitors), business services, automobile services, entertainment and recreation, medical and health care, legal, educational and social services, museums and zoos, nonprofit organizations, management, consulting and other professional services, and government. However, each of these industry groups makes greater or lesser contributions to the total exports of the region.

Export-producing industries link the individual LMAs to each other and to regional, national and global markets. And they generate the commodity tonnage (defined as shipments of all products) transported from one LMA to another. They also serve the passenger traffic between LMAs and global origins and destinations.

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[6]These are delineated by and used by the USDA.

Residentiary industries. The residentiary sector of local industries supports the export-producing sector and serves the resident population of a local labor market area. This sector is increasingly important to the success of the local export-producing sector, firstly, by providing essential production inputs and, secondly, by providing attractive goods and services for the resident population's consumption.

The residentiary sector includes local infrastructure--transportation and communication facilities and services as well as other producer services. It also includes portions of all consumer services industries. The presence of these functions distinguish core LMAs from peripheral and transitional ones. The residentiary sector represents the endogenous factor in regional growth and change.

Metropolitan core area. Proximity to metropolitan areas further differentiates local labor markets. The metropolitan areas, like the combined 12-county Minneapolis-St. Paul labor market area (LMA) and the contiguous four-county St. Cloud LMA represent the core LMA for the Upper Midwest.

Study findings show that core labor market areas are characterized by a similarity of economic functions and roles in the emerging global information economy. (Reynolds and Maki, 1991) They are the world class transportation, telecommunications and distribution centers. They have a rich diversity of basic industries--the export-producing and export-serving sectors of manufacturing, transportation, finance, insurance, banking, business and other producer services, and consumer services like entertainment, recreation and health care. Most important, however, metropolitan core areas offer the strategic management functions in the downtown district. Such functions require one-on-one relationships between information providers and information users. They include the highly differentiated information-related services necessary for achieving and maintaining the competitive edge of local businesses in regional and world markets.

Transitional rural area. Between the core LMA and its periphery are the transitional rural areas. The transitional LMAs closest to the core area experience rapid population and job growth. They have an expanding manufacturing base as a result of low site costs--rent, labor, and environmental, coupled with excellent access to metropolitan area markets. For many counties in the transitional areas, the percentage rates of growth exceed those in the metropolitan core area.

Peripheral area. The periphery of the multi-area economic region is characterized by LMAs furthest removed from the core LMA functions. The peripheral LMAs lack convenient and low-cost access to decision information for business enterprise. They are vulnerable to the general business cycle and the product cycles of the standardized, highly tradeable commodities that typically are produced there.

The low-cost producer dominates competition in commodity markets. For the export-producing businesses in the periphery, this translates into extreme dependence on low wages or, alternatively, on high productivity in resource use. High labor and total factor productivity, in

turn, depend on high levels of investment per worker. Most businesses in the periphery suffer from low investment per worker.

Employment Growth, Business Formation and Income

Industry Employment Growth. Growth in total labor earnings of industry employment is one of two measures of economic well-being used in this study. Labor earnings account for 70 to 80 percent of personal income. The other two components--property income and transfer payments--split the remainder, with roughly equal amounts contributed by each. The other measure of local economic well-being is total industry employment.

Figure 4.2 shows LMAs of the US by growth in total jobs over the period from 1978 to 1988. The largest concentration of low rates of job growth is in the Northern Transportation Corridor. This includes the six Upper Midwest states. Within the Upper Midwest boundaries, however, are two high growth LMAs -- Minneapolis-St. Paul and St. Cloud.

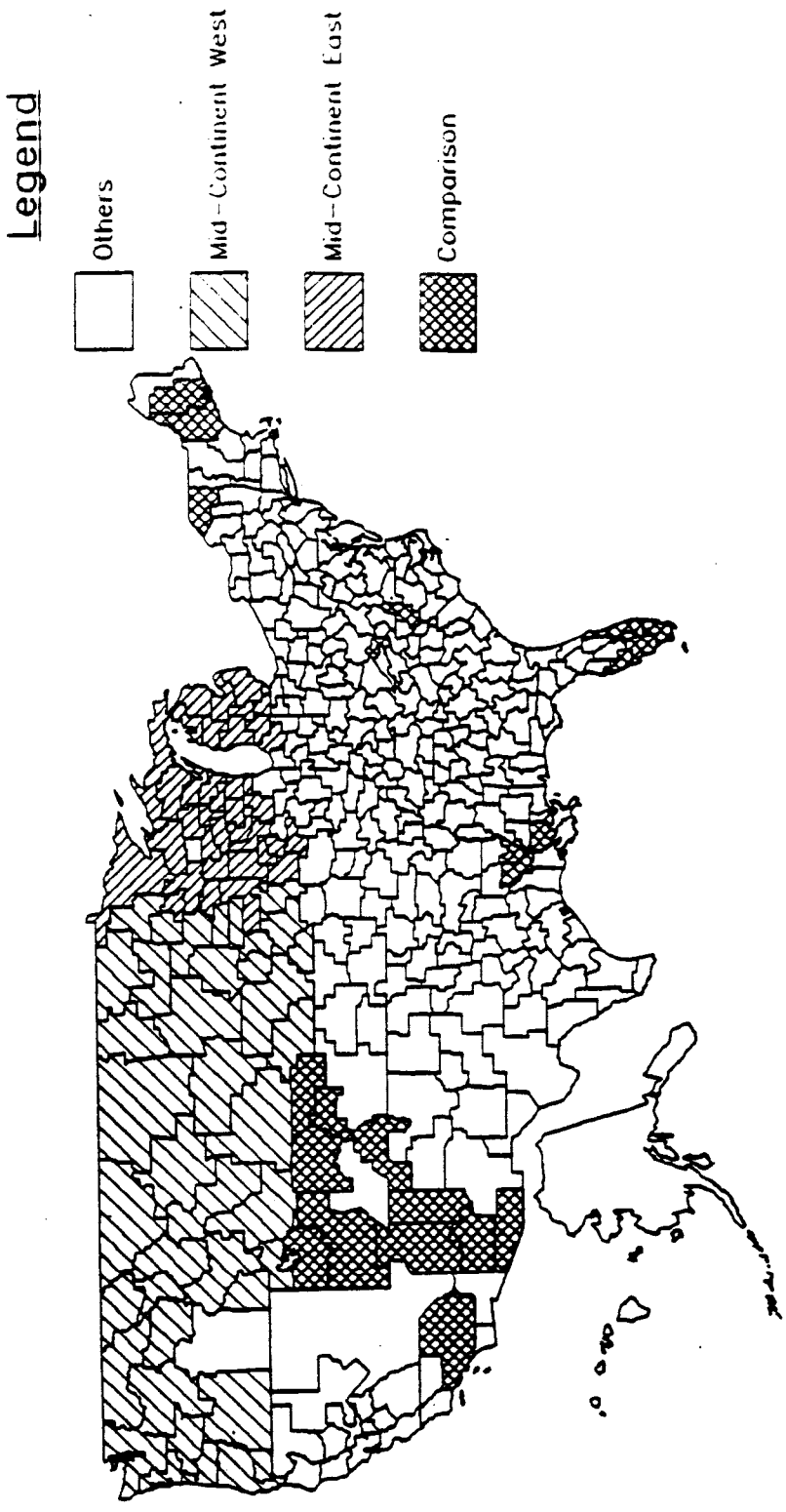
Income Growth and Volatility. To better measure these relative changes, income volatility was calculated for each of 100 LMAs from 1970 to 1986. Table 4.1 lists two statistics--an income volatility index and an income growth index--for each labor market area (LMA). The income volatility index represents the frequency of change in labor earnings while the growth index depicts total change in labor earnings.[7] These volatility measures (not to be confused with business volatility) are simply summary statistics for describing the economic history of each of the 100 LMAs.

The 77 LMAs in the Northern Transportation Corridor split into two parts. Forty LMAs are in Mid-continent West and 37 LMAs are in Mid-continent East. The remaining 23 comparison LMAs include both rapidly growing and generally declining base economies that vary in income volatility and overall growth from the lowest to among the highest. They allow comparison with a wide range of regional basic industries and growth histories.

Both the income volatility index and the income growth index refer to change over the entire 1970 to 1986 period. This analysis includes the two long periods of economic recovery -- 1970 to 1980 and 1982 to 1986 -- separated by two recessions occurring in the 1980-82 period. Over the 16-year period, total labor earnings -- the principal source of personal income -- increased by more than $782 billion (in 1982 dollars). It increased from $1,426 billion in 1970 to $2,208 billion in 1986. The comparison LMAs increased its share of total US labor earnings from 10.6 percent in 1970 to 12.8 percent in 1986. However, the Mid-continent East (or Upper Midwest) region dropped from 9.5 percent of the total to 8.4 percent.

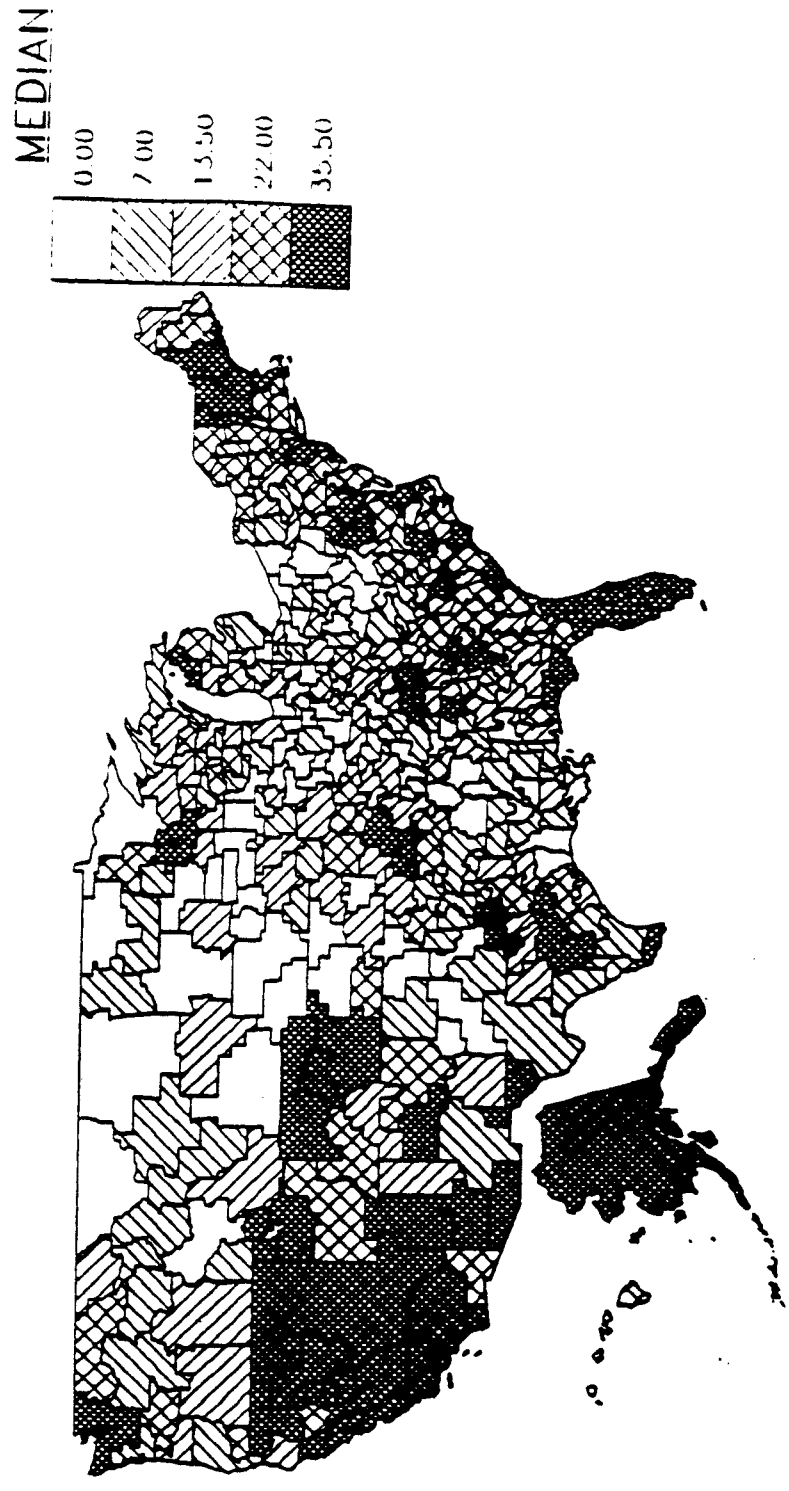
The income volatility index is the ratio of the normalized value of the absolute annual change in total area earnings to total earnings. The income growth index is the normalized value of the ratio of total earnings change over the 1970-86 period to total earnings.

Figure 4.1
Labor Market Areas Selected for Shift-Share Analysis



Source: Reynolds, Paul D. and Wilbur Maki. 1991. "U.S. Regional Characteristics that Promote Regional Growth". Final project report submitted to Aspen Institute in fulfillment of Ford Foundation Grant No. 8900-013, University of Minnesota Grant No. 0610-5764, Minneapolis, MN.

Figure 4.2
Percentage Job Growth by U.S. Labor Market Area : 1978-1988



Source: Reynolds, Paul D. and Wilbur Maki. 1991. "U.S. Regional Characteristics that Promote Regional Growth". Final project report submitted to Aspen Institute in fulfillment of Ford Foundation Grant No. 8900-013, University of Minnesota Grant No. 0610-5764, Minneapolis, MN.

Figure 4.3

Table 1. Total labor earnings (1982 $) for all industry and volatility and growth indexes of specified labor market areas: "Mid-Continent West, Mid-Continent East and Comparison Labor Market Areas, US, 1970-1986"

No.	Labor Market Area	Labor Earnings LMA	1970	1986	Volat Index	Growth Index
			(mil.$)	(mil.$)	(Rank)	(Rank)
1	WA-OR:WALLA WALLA AREA	2	2664	4379	25	37
2	WA-ID:SPOKANE AREA	3	2887	4570	73	40
3	ID-WA:LEWISTON AREA	4	833	1061	53	78
4	OR-CA:EUGENE AREA	5	2253	3203	23	62
5	OR:BEND (CENTRAL)	6	773	1186	19	51
6	OR:MEDFORD (SW)	7	669	1221	26	23
7	OR:SALEM AREA	8	1998	3243	47	33
8	OR-WA:PORTLAND AREA	9	8270	13467	54	38
9	OR-WA:LONGVIEW-COAST	10	1282	1690	24	58
10	WA:SEATTLE-TACOMA MET	11	17344	30708	81	18
11	ID:SOUTH CENTRAL	40	635	904	31	69
12	ID:POCATELLO AREA	41	1131	1784	67	42
13	WY-ID-UT:ROCK SPRINGS	42	420	1130	4	2
14	UT-ID:LOGAN AREA	43	376	774	92	11
15	MT-ID:KALISPELL AREA	46	460	661	63	52
16	MT:MISSOULA AREA	47	441	728	36	35
17	MT:BUTTE-HELENA AREA	48	702	855	70	79
18	MT-WY:BILLINGS AREA	49	980	1521	18	32
19	WY-MT:YELLOWSTONE N P	50	539	847	7	45
20	MT:GREAT FALLS AREA	51	1124	1141	35	100
21	NE-CO:NORTH PLATTE AR	66	822	1140	30	47
22	NE:GRAND ISLAND AREA	67	1720	2389	2	36
23	NE-IA-MO:OMAHA METRO	68	5668	7716	43	59
24	NE:LINCOLN METRO	69	1942	2811	21	46
25	IA-NE-SD:SOUIX CITY	70	1258	1506	66	82
26	NE-SD:NORFOLK AREA	71	557	805	6	41
27	SD:SOUIS FALLS AREA	72	1642	2351	89	56
28	WY-NE:CHEYENNE AREA	73	1592	2486	1	60
29	SD-NE-WY:RAPID CITY A	74	976	1720	11	17
30	SD-ND:ABERDEEN-WEST	75	896	1019	28	86
31	IA-MO:DES MOINES METR	76	4004	5390	94	66
32	IA:SPENCER (NW) AREA	77	903	1017	27	97
33	MN:WORTHINGTON (SE)	78	788	844	60	98
34	MN:BEMIDJI-N CENTRAL	79	507	811	56	30
35	MN:ALEXANDRIA AREA	80	622	847	58	63
36	MN-SD:MORRIS-SISSETON	81	1113	1362	34	88
37	ND-MN:FARGO-MOOREHEAD	82	1324	1934	69	48
38	ND-MN:GRAND FORKS ARE	83	1297	1754	33	64
39	ND:MINOT-BISMARK AREA	84	1033	1633	20	24
40	ND-MT-SD:DICKINSON AR	85	989	1206	9	73
	Total Mid-continent West		75431	116013		
41	IA-IL:DUBUQUE AREA	146	1529	1669	64	96
42	WI:MADISON AREA	147	3049	4447	84	53
43	WI:PLATTEVILLE AREA	148	686	801	39	92
44	IA-IL-MO:BURLINGTON	149	1442	1606	90	91
45	IA:OTTUMWA AREA	150	1263	1495	57	85
46	IA:CEDAR RAPIDS AREA	151	1654	2049	71	83
47	IA:IOWA CITY AREA	152	982	1557	42	28
48	IA:WATERLOO AREA	153	2275	2520	40	94
49	IA-MN:MASON CITY AREA	154	2229	2456	41	95
50	MN-WI:DULUTH AREA	155	2243	2474	37	93
51	MN-WI:MPLS-ST PAUL ME	156	17234	28692	50	26
52	MN:ST CLOUD AREA	157	783	1390	76	20
53	MN:MANKATO AREA	158	1323	1788	80	67
54	MN:ROCHESTER AREA	159	1476	2136	75	54
55	WI:NORTHWEST AREA	160	629	1041	77	29
56	WI-MN:LA CROSSE AREA	161	952	1466	78	44
57	WI-MN:WINONA MN AREA	162	506	698	62	65
58	IN-MI:SOUTH BEND AREA	261	4996	6595	13	61
59	MI:KALAMAZOO AREA	262	3491	4564	86	72
60	MI:GRAND RAPID AREA	263	5843	9094	49	39
61	MI:LANSING AREA	264	2915	4491	88	43
62	MI:MIDLAND AREA	265	3473	4509	55	77
63	MI:DETROIT METRO	266	42911	55904	17	74
64	MI:JACKSON AREA	267	1774	1819	79	99
65	MI:HURON FOREST AREA	268	607	801	32	81
66	MI:TRAVERSE CITY (NW)	269	709	1236	51	27
67	MI:CADILLAC AREA	270	566	752	44	75
68	IL-WI:ROCKFORD AREA	271	4413	5612	45	70
69	WI:STEVENS POINT AREA	272	735	1274	83	22
70	WI:WAUSAU AREA	273	909	1380	68	50
71	WI:GREEN BAY AREA	274	1447	2499	85	21
72	WI:OSHKOSH AREA	275	3202	4703	97	49
73	WI:FOND DU LAC AREA	276	751	992	91	68
74	WI:MILWAUKEE METRO	277	12088	15504	93	76
75	WI:KENOSHA AREA	278	2153	2676	29	80
76	MI-WI:UPPER PENNSULIA	279	1236	1424	65	90
77	WI-MI:IRON MOUNTAIN	280	725	1062	72	57
	Total Mid-continent East		135197	185176		
78	AZ:HOLBROOK (NE)	12	3190	672	38	87
79	AZ:PHOENIX METRO	13	7442	19696	98	4
80	AZ:TUSCON METRO	14	2527	5429	96	9
81	AZ-UT:FLAGSTAFF-CANYO	15	463	1068	82	7
82	NM:DURANGO-TAOS	16	535	1202	5	10
83	CO:DENVER METRO	19	9760	22467	46	8
84	CO:GRAND JUNCTION-NW	21	765	1884	3	6
85	CA:LOS ANGELES METRO	25	82481	147132	52	19
86	UT:SALT LAKE CITY MET	44	5408	10363	61	15
87	UT:CEDAR CITY-PRICE	45	512	1090	8	12
88	CO:FT COLLINS-NE AREA	65	1340	2648	59	13
89	NY:NORTHEAST AREA	195	1361	1700	16	71
90	ME:PORTLAND METRO	196	3487	5680	22	25
91	ME:BANGOR METRO	197	1048	1609	48	34
92	WV-VA:BLUEFIELD	207	844	948	14	89
93	FL:WEST PALM BEACH	318	4700	11839	95	5
94	FL:MIAMI METRO	319	14037	26961	87	14
95	FL:SARASOTA AREA	320	1274	3414	99	3
96	FL:FT MYERS AREA	321	982	2973	100	1
97	NC-VA:GREENBOROUGH AR	333	4574	7045	15	31
98	LA:BATON ROUGE METRO	373	3004	5483	10	16
99	LA:ALEXANDRIA AREA	374	933	1326	74	55
100	LA-MS:NATCHEZ MS AREA	375	456	542	12	84
	Total Comparison LMAs		151140	283169		
	Total US		1425767	2288097		

Source: Reynolds, Paul D. and Wilbur Maki. 1991. "U.S. Regional Characteristics that Promote Regional Growth". Final project report submitted to Aspen Institute Washington, DC in fulfillment of Ford Foundation Grant No. 8900-013, University of Minnesota Grant No. 0610-5764, Minneapolis, MN.

Figure 4.4

Table 2. Total and relative labor earnings (in 1982$) and period-to-period change sources:* by regional groupings of US labor market areas, 1970-86*

No.	Year and Change Source	Total Labor Earnings (1982$) Mid-Continent West	Mid-Continent East	Comparis LMAs	Other LMAs	All LMAs	Proportion of Total Mid-Continent West	Mid-Continent East	Comparis LMAs	Other LMAs	All LMAs
		(mil.$)	(mil.$)	(mil.$)	(mil.$)	(mil.$)	(pct.)	(pct.)	(pct.)	(pct.)	(pct.)
1	*1970, Totals*	75431	135197	151140	1063999	1425767	5.3	9.5	10.6	74.6	100.0
2	US Growth	25388	45504	50870	358114	479875	33.7	33.7	33.7	33.7	33.7
3	Industry Mix	-2452	-1462	-258	4172	0	-3.3	-1.1	-0.2	0.4	0.0
4	Regional Share	12756	-6483	30157	-36430	0	16.9	-4.8	20.0	-3.4	0.0
5	Relative Change	10304	-7945	29899	-32258	0	13.7	-5.9	19.8	-3.0	0.0
6	*1980, Totals*	111123	160930	227790	1405800	1905643	5.8	8.4	12.0	73.8	100.0
7	US Growth	-1364	-1975	-2796	-17257	-23393	-1.2	-1.2	-1.2	-1.2	-1.2
8	Industry Mix	-2426	-7870	4813	5482	0	-2.2	-4.9	2.1	0.4	0.0
9	Regional Share	-3790	-9845	4969	8667	0	-3.4	-6.1	2.2	0.6	0.0
10	Relative Change	-6216	-17715	9782	14149	0	-5.6	-11.0	4.3	1.0	0.0
11	*1982, Totals*	104743	157678	231738	1388091	1882250	5.6	8.4	12.3	73.7	100.0
12	US Growth	13514	20343	29898	179088	242844	12.9	12.9	12.9	12.9	12.9
13	Industry Mix	-307	-705	3361	-2350	0	-0.3	-0.4	1.5	-0.2	0.0
14	Regional Share	-6244	340	4888	1016	0	-6.0	0.2	2.1	0.1	0.0
15	Relative Change	-6550	-365	8249	-1333	0	-6.3	-0.2	3.6	-0.1	0.0
16	*1985, Totals*	111707	177657	269885	1565845	2125094	5.3	8.4	12.7	73.7	100.0
17	US Growth	4363	6939	10541	61160	83004	3.9	3.9	3.9	3.9	3.9
18	Industry Mix	188	-916	1107	-380	0	0.2	-0.5	0.4	0.0	0.0
19	Regional Share	-245	1496	1636	-2887	0	-0.2	0.8	0.6	-0.2	0.0
20	Relative Change	-57	581	2743	-3266	0	-0.1	0.3	1.0	-0.2	0.0
21	*1986, Totals*	116013	185176	283169	1623739	2208097	5.3	8.4	12.8	73.5	100.0
22	*Change Sources Summary, 1970-86:*										
23	US Growth	41901	70811	88513	581104.9618	782330	55.5	52.4	58.6	54.6	54.9
24	Industry Mix	-4996	-10953	9024	6925	0	-6.6	-8.1	6.0	0.7	0.0
25	Regional Share	2477	-14492	41649	-29634	0	3.3	-10.7	27.6	-2.8	0.0
26	Relative Change	-2519	-25444	50673	-22709	0	-3.3	-18.8	33.5	-2.1	0.0
27	Total Change	39381	45366	139186	558396	782330	52.2	33.6	92.1	52.5	54.9

Source: Reynolds, Paul D. and Wilbur Maki. 1991. "U.S. Regional Characteristics that Promote Regional Growth". Final project report submitted to Aspen Institute Washington, DC in fulfillment of Ford Foundation Grant No. 8900-013, University of Minnesota Grant No. 0610-5764, Minneapolis, MN.

Figure 4.5

Table 3. Total change in labor earnings (1982 $) from all industry due to relative change effect in 30 highest volatility and 30 lowest volatility areas: Mid-Continent West, Mid-Continent East and Comparison Labor Market Areas, US, 1970-1986

Rnk	Labor Market Area	LMA No.	1970	Change, 1970-80 US Growth	Ind Mix	Reg Share	1980	Change, 1980-82 US Growth	Ind Mix	Reg Share	1982	Change, 1982-85 US Growth	Ind Mix	Reg Share	1985	Change, 1985-86 US Growth	Ind Mix	Reg Share	1986
			(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)
1	WY-NE:CHEYENNE AREA	73	1592	536	91	1100	3319	-41	-331	-372	2905	375	-149	-533	2598	101	-50	-163	2486
2	NE:GRAND ISLAND AREA	67	1720	579	-208	-140	1951	-24	293	269	2175	281	-31	-86	2339	91	25	-66	2389
3	CO:GRAND JUNCTION-NW	21	765	257	78	878	1978	-24	-66	281	2169	280	-47	-487	1915	75	-2	-103	1884
4	WY-ID-UT:ROCK SPRINGS	42	420	141	8	582	1152	-14	71	57	1179	152	-88	-68	1175	46	-42	-49	1130
5	NM:DURANGO-TAOS	16	555	187	36	490	1267	-16	0	-1	1250	161	-45	-140	1226	48	-22	-50	1202
6	NE-SD:NORFOLK AREA	71	557	187	-54	-3	687	-8	46	38	712	92	-11	-32	761	30	5	9	805
7	WY-MT:YELLOWSTONE N P	50	539	181	39	236	995	-12	-53	-65	902	116	-42	-97	879	34	-10	-57	847
8	UT:CEDAR CITY-PRICE	45	512	172	27	330	1042	-13	-10	108	1127	145	-107	-25	1140	45	-22	-73	1090
9	ND-MT-SD:DICKINSON AR	85	989	333	-96	142	1368	-17	69	52	1437	185	-74	-410	1139	44	-26	49	1206
10	LA:BATON ROUGE METRO	373	3004	1011	60	1598	5673	-70	196	126	5735	740	-70	-605	5800	227	-12	-532	5483
11	SD-NE-WY:RAPID CITY A	74	976	328	-36	382	1650	-20	108	88	1711	221	-106	-122	1704	67	-41	-9	1720
12	LA-MS:NATCHEZ MS AREA	375	456	154	49	-24	635	-8	-1	-8	627	81	-23	-89	595	23	-13	-64	542
13	IN-MI:SOUTH BEND AREA	261	4996	1681	-31	-912	5734	-70	-37	-107	5413	698	-40	166	6238	244	-63	177	6595
14	WV-VA:BLUEFIELD	207	844	284	253	-212	1168	-14	-48	-63	1066	138	-118	-122	963	38	-31	-22	948
15	NC-VA:GREENBOROUGH AR	333	4574	1540	-488	224	5850	-72	160	88	5744	741	-77	316	6725	263	-18	76	7045
16	NY:NORTHEAST AREA	195	1361	458	-81	-241	1497	-18	14	-5	1459	188	-62	70	1655	65	-19	-1	1700
17	MI:DETROIT METRO	266	42911	14443	-117	-5082	40329	-495	-4148	-4643	45071	5815	570	2223	53679	2097	-321	450	55904
18	MT-WY:BILLINGS AREA	49	980	330	0	307	1617	-20	44	24	1617	209	-44	-263	1518	59	-21	-36	1521
19	OR:BEND (CENTRAL)	6	773	260	-9	202	1227	-15	-125	-140	1009	130	8	19	1166	46	6	-32	1186
20	ND:MINOT-BISMARK AREA	84	1033	348	-114	233	1499	-18	127	108	1602	207	-25	-118	1666	65	0	-99	1633
21	NE:LINCOLN METRO	69	1942	654	-63	-110	2422	-30	87	58	2455	317	-25	-4	2742	107	12	-50	2811
22	ME:PORTLAND METRO	196	3487	1174	-191	119	4589	-56	133	77	4568	589	-65	140	5232	204	-14	257	5680
23	OR-CA:EUGENE AREA	5	2253	758	119	349	3481	-43	-371	-414	2846	367	47	-146	3115	122	13	-47	3203
24	OR-WA:LONGVIEW-COAST	10	1282	431	34	247	1994	-24	-59	-83	1764	228	-1	-326	1665	65	-1	-39	1690
25	WA-OR:WALLA WALLA AREA	2	2664	897	-131	1126	4555	-56	-230	-286	4203	542	-38	-550	4158	162	28	31	4379
26	OR:MEDFORD (SW)	7	669	225	27	284	1205	-15	-123	-138	1014	131	15	11	1171	46	5	-1	1221
27	IA:SPENCER (NW) AREA	77	903	304	-144	-2	1061	-13	-141	-154	885	114	-5	-38	956	37	12	11	1017
28	SD-ND:ABERDEEN-WEST	75	896	302	-144	-143	911	-11	-26	-37	864	111	-5	-86	885	35	10	89	1019
29	WI:KENOSHA AREA	278	2153	725	2	118	2998	-37	-192	-229	2648	342	-41	-271	2678	105	-35	-72	2676
30	NE-CO:NORTH PLATTE AREA	66	822	277	-101	47	1044	-13	49	36	1045	135	-29	-22	1129	44	5	-38	1140
	30 Highest-volatility LMAs		**86627**	**29156**	**-1187**	**2127**	**104896**	**-1288**	**-4564**	**-5335**	**107284**	**13831**	**-727**	**-1696**	**118612**	**4633**	**-642**	**-455**	**122148**
71	IA:CEDAR RAPIDS AREA	151	1654	557	-81	-36	2094	-26	-140	-165	1878	242	-31	-133	1956	76	-12	28	2049
72	WI-MI:IRON MOUNTAIN	280	725	244	-5	71	1035	-13	-68	-81	928	120	-14	-7	1027	40	-7	2	1062
73	WA-ID:SPOKANE AREA	3	2887	972	-23	646	4482	-55	-237	-292	4029	520	-77	-73	4399	172	4	-5	4570
74	LA:ALEXANDRIA AREA	374	933	314	-34	83	1297	-16	9	-7	1283	166	-7	-98	1344	52	2	-73	1326
75	MN:ROCHESTER AREA	139	1476	497	-69	-8	1897	-23	-24	-48	1835	237	-44	-12	2016	79	-6	47	2136
76	MN:ST CLOUD AREA	157	783	264	-62	180	1165	-14	-4	-19	1123	145	-13	19	1274	50	3	64	1390
77	WI:NORTHWEST AREA	160	629	212	-30	120	931	-11	-38	-49	857	111	-9	5	963	38	2	38	1041
78	WI-MN:LA CROSSE AREA	161	952	320	-40	189	1421	-17	-50	-68	1322	171	-24	-69	1400	55	-6	18	1466
79	MI:JACKSON AREA	267	1774	597	29	-459	1941	-24	-142	-166	1716	221	6	-158	1784	70	-22	-13	1819
80	MN:MANKATO AREA	158	1323	445	-121	36	1683	-21	-59	-80	1567	202	-25	-59	1685	66	-2	39	1788
81	WA:SEATTLE-TACOMA MET	11	17344	5837	-56	4050	27175	-334	269	-65	26364	3401	526	-1446	28845	1127	84	652	30708
82	AZ-UT:FLAGSTAFF-CANYO	15	463	156	-2	259	875	-11	-10	-20	829	107	-13	69	992	39	0	37	1068
83	WI:STEVENS POINT AREA	272	735	247	-18	176	1140	-14	-8	-22	1098	142	-20	3	1223	48	3	0	1274
84	WI:MADISON AREA	147	3049	1026	-54	-70	3951	-49	-53	-101	3842	496	9	-161	4186	164	31	66	4447
85	WI:GREEN BAY AREA	274	1447	487	-44	283	2173	-27	-14	-41	2082	269	-27	40	2364	92	-10	53	2499
86	MI:KALAMAZOO AREA	262	3491	1175	-74	-209	4383	-54	-191	-244	4034	521	-113	-72	4369	171	-48	72	4564
87	FL:MIAMI METRO	319	14037	4724	491	2866	22118	-272	564	293	22245	2870	612	-127	25600	1000	339	21	26961
88	MI:LANSING AREA	264	2915	981	23	182	4101	-50	-117	-168	3848	496	59	-36	4367	171	-2	-44	4491
89	SD:SOUIS FALLS AREA	72	1642	552	-146	124	2172	-27	-63	-90	2056	265	-23	-3	2296	90	20	-54	2351
90	IA-IL-MO:BURLINGTON	149	1442	485	-69	-163	1696	-21	-90	-111	1534	198	-42	-116	1573	61	-10	-18	1606
91	WI:FOND DU LAC AREA	276	751	253	-33	-16	954	-12	-27	-38	886	114	-27	-26	948	37	-9	16	992
92	UT-ID:LOGAN AREA	43	376	126	-41	157	618	-8	20	12	608	78	-16	47	718	28	-10	39	774
93	WI:MILWAUKEE METRO	277	12088	4068	75	-1080	15151	-186	-522	-708	14185	1830	-132	-874	15010	586	-88	-4	15504
94	IA-MO:DES MOINES METR	76	4004	1348	-115	91	5327	-65	-236	-302	4999	645	21	-294	5371	210	43	-35	5590
95	FL:WEST PALM BEACH	318	4700	1582	131	1958	8370	-103	582	479	8646	1115	242	1035	11039	431	83	286	11839
96	AZ:TUSCON METRO	14	2527	851	-29	926	4276	-52	188	135	4316	557	-53	313	5133	200	0	96	5429
97	WI:OSHKOSH AREA	275	3202	1078	-114	214	4380	-54	-96	-150	4082	527	-84	-41	4485	175	-39	82	4703
98	AZ:PHOENIX METRO	13	7442	2505	150	4093	14190	-174	462	288	14233	1836	204	2027	18300	715	205	476	19696
99	FL:SARASOTA AREA	320	1274	429	5	843	2550	-31	86	55	2537	327	86	219	3170	124	37	83	3414
100	FL:FT MYERS AREA	321	982	330	-27	850	2135	-26	124	98	2152	278	77	220	2727	107	44	95	2973
	30 Lowest-volatility LMAs		**97846**	**32663**	**-382**	**16356**	**145682**	**-1788**	**113**	**-1675**	**141115**	**18286**	**1047**	**195**	**160563**	**6271**	**629**	**2063**	**169526**

Source: Reynolds, Paul D. and Wilbur Maki. 1991. "U.S. Regional Characteristics that Promote Regional Growth". Final project report submitted to Aspen Institute Washington DC in fulfillment of Ford Foundation Grant No. 890-013, University of Minnesota Grant No. 0610-5764, Minneapolis, MN.

Figure 4.6

Table 4: Total change in labor earnings (1982 $) from all industry due to relative change effect in 30 fastest-growing and 30 slowest-growing areas: Mid-Continent West, Mid-Continent East and Comparison Labor Market Areas, US, 1970-1986

Rnk	Labor Market Area	LMA No.	1970	US Growth	Ind Mix	Reg Share	1980	US Growth	Ind Mix	Reg Share	1982	US Growth	Ind Mix	Reg Share	1985	US Growth	Ind Mix	Reg Share	1986
			(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)	(mil$)
	Change, 1970-80									Change, 1980-82				Change, 1982-85				Change, 1985-86	
1	FL:FT MYERS AREA	321	982	330	-27	850	2135	-26	124	98	2152	278	77	220	2727	107	44	95	2973
2	WY-ID-UT:ROCK SPRINGS	42	420	141	8	582	1152	-14	71	57	1179	152	-88	-68	1175	46	-42	-49	1130
3	FL:SARASOTA AREA	320	1274	429	5	843	2550	-31	86	55	2537	327	86	219	3170	124	37	83	3414
4	AZ:PHOENIX METRO	13	7442	2505	150	4093	14190	-174	462	288	14233	1836	204	2027	18300	715	205	476	19696
5	FL:WEST PALM BEACH	318	4700	1582	131	1958	8370	-103	582	479	8646	1115	242	1035	11039	431	83	286	11839
6	CO:GRAND JUNCTION-NW	21	765	257	78	878	1978	-24	-66	281	2169	280	-47	-487	1915	75	-2	-103	1884
7	AZ-UT:FLAGSTAFF-CANYO	15	463	156	-2	259	875	-11	-10	-20	829	107	-13	69	992	39	0	37	1068
8	CO:DENVER METRO	19	9760	3285	472	4788	18304	-225	149	1708	19937	2572	53	-478	22084	863	11	-490	22467
9	AZ:TUSCON METRO	14	2527	851	-29	926	4276	-52	188	135	4316	557	-53	313	5133	200	0	96	5429
10	NM:DURANGO-TAOS	16	555	187	36	490	1267	-16	0	-1	1250	161	-45	-140	1226	48	-22	-50	1202
11	UT-ID:LOGAN AREA	43	376	126	-41	157	618	-8	20	12	608	78	-16	47	718	28	-10	39	774
12	UT:CEDAR CITY-PRICE	45	512	172	27	330	1042	-13	-10	108	1127	145	-107	-25	1140	45	-22	-73	1090
13	CO:FT COLLINS-NE AREA	65	1340	451	-136	681	2336	-29	-12	14	2308	298	-22	1	2585	101	-1	-37	2648
14	FL:MIAMI METRO	319	14037	4724	491	2866	22118	-272	564	293	22245	2870	612	-127	25600	1000	339	21	26961
15	UT:SALT LAKE CITY MET	44	5408	1820	-20	1745	8953	-110	-98	303	9049	1167	-116	114	10214	399	-46	-203	10363
16	LA:BATON ROUGE METRO	373	3004	1011	60	1598	5673	-70	196	126	5735	740	-70	-605	5800	227	-12	-532	5483
17	SD-NE-WY:RAPID CITY A	74	976	328	-36	382	1650	-20	108	88	1711	221	-106	-122	1704	67	-41	-9	1720
18	WA:SEATTLE-TACOMA MET	11	17344	5837	-56	4050	27175	-334	269	-65	26364	3401	526	-1446	28845	1127	84	652	30708
19	CA:LOS ANGELES METRO	25	82481	27761	61	7605	116659	-1432	2404	1056	118524	15292	2967	2469	139272	5440	605	1815	147132
20	MN:ST CLOUD AREA	157	783	264	-62	180	1165	-14	-4	-19	1123	145	-13	19	1274	50	3	64	1390
21	WI:GREEN BAY AREA	274	1447	487	-44	283	2173	-27	-14	-41	2082	269	-27	40	2364	92	-10	53	2499
22	WI:STEVENS POINT AREA	272	735	247	-18	176	1140	-14	-8	-22	1096	142	-20	3	1223	48	3	0	1274
23	OR:MEDFORD (SW)	7	669	225	27	284	1205	-15	-123	-138	1014	131	15	11	1171	46	5	-1	[illegible]
24	ND:MINOT-BISMARK AREA	84	1033	348	-114	233	1499	-18	127	108	1602	207	-25	-118	1666	65	0	-99	[illegible]
25	ME:PORTLAND METRO	196	3487	1174	-191	119	4589	-56	133	77	4568	589	-65	140	5232	204	-14	257	[illegible]
26	MN-WI:MPLS-ST PAUL ME	156	17234	5800	410	561	24005	-295	186	-109	23594	3044	15	837	27490	1074	1	127	28692
27	MI:TRAVERSE CITY (NW)	269	709	238	13	117	1078	-13	-68	-81	986	127	-7	46	1152	45	-5	44	1236
28	IA:IOWA CITY AREA	152	982	331	-62	152	1403	-17	50	33	1420	183	-13	-108	1483	58	5	11	1557
29	WI:NORTHWEST AREA	160	629	212	-30	120	931	-11	-38	-49	857	111	-9	5	963	38	2	38	1041
30	MN:BEMIDJI-N CENTRAL	79	507	171	-21	43	700	-9	-1	-9	677	87	-5	11	771	30	4	7	811
	30 FASTEST-GROWING LMAS		182578	61451	1080	37348	281208	-3452	5264	4764	283941	36633	3950	3982	328426	12828	1204	2554	345012
71	NY:NORTHEAST AREA	195	1361	458	-81	-241	1497	-18	14	-5	1459	188	-62	70	1655	65	-19	-1	1700
72	MI:KALAMAZOO AREA	262	3491	1175	-74	-209	4383	-54	-191	-244	4034	521	-113	-72	4369	171	-48	72	4564
73	ND-MT-SD:DICKINSON AR	85	989	333	-96	142	1368	-17	69	52	1437	185	-74	-410	1139	44	-26	49	1206
74	MI:DETROIT METRO	266	42911	14443	-117	-5082	40329	-495	-4148	-4643	45071	5815	570	2223	53679	2097	-321	450	55904
75	MI:CADILLAC AREA	270	566	191	-12	-13	731	-9	-54	-63	649	84	-10	7	730	28	-4	-2	752
76	WI:MILWAUKEE METRO	277	12088	4068	75	-1080	15151	-186	-522	-708	14185	1830	-132	-874	15010	586	-88	-4	15504
77	MI:MIDLAND AREA	265	3473	1169	-67	28	4603	-56	-319	-375	4090	528	-45	-115	4457	174	-58	-63	4509
78	ID-WA:LEWISTON AREA	4	833	280	-53	50	1111	-14	-81	-95	972	125	-3	-64	1030	40	9	-18	1061
79	MT:BUTTE-HELENA AREA	48	702	236	8	-53	893	-11	-15	-26	851	110	-21	-101	840	33	0	-17	855
80	WI:KENOSHA AREA	278	2153	725	2	118	2998	-37	-192	-229	2648	342	-41	-271	2678	105	-35	-72	2676
81	MI:HURON FOREST AREA	268	607	204	-29	-8	774	-10	-78	-88	682	88	-14	6	762	30	-9	18	801
82	IA-NE-SD:SOUIX CITY	70	1258	423	-86	-122	1473	-18	-22	-40	1422	184	-24	-123	1459	57	10	-20	1506
83	IA:CEDAR RAPIDS AREA	151	1654	557	-81	-36	2094	-26	-140	-165	1878	242	-31	-133	1956	76	-12	28	2049
84	LA-MS:NATCHEZ MS AREA	375	456	154	49	-24	635	-8	-1	-8	627	81	-23	-89	595	23	-13	-64	542
85	IA:OTTUMWA AREA	150	1263	425	-117	-104	1467	-18	-86	-104	1325	171	-29	-46	1421	56	-6	25	1495
86	SD-ND:ABERDEEN-WEST	75	896	302	-144	-143	911	-11	-26	-37	864	111	-5	-86	885	35	10	89	1019
87	AZ:HOLBROOK (NE)	12	3190	1074	-1004	235	634	-8	-24	-31	584	75	-42	19	636	25	-10	21	672
88	MN-SD:MORRIS-SISSETON	81	1113	375	-188	78	1378	-17	-155	-172	1175	152	-20	-22	1285	50	14	13	1362
89	WV-VA:BLUEFIELD	207	844	284	253	-212	1168	-14	-48	-63	1066	138	-118	-122	963	38	-31	-22	948
90	MI-WI:UPPER PENNSULIA	279	1236	416	-18	-163	1472	-18	-117	-135	1298	167	-37	-78	1350	53	-8	29	1424
91	IA-IL-MO:BURLINGTON	149	1442	485	-69	-163	1696	-21	-90	-111	1534	198	-42	-116	1573	61	-10	-18	1606
92	WI:PLATTEVILLE AREA	148	686	231	-100	39	855	-11	-70	-80	761	98	-4	-144	712	28	4	58	801
93	MN-WI:DULUTH AREA	155	2243	755	23	-79	2941	-36	-215	-251	2522	325	-175	-232	2440	95	-26	-35	2474
94	IA:WATERLOO AREA	153	2275	766	-161	51	2932	-36	-196	-232	2617	338	-53	-432	2470	96	-13	-33	2520
95	IA-MN:MASON CITY AREA	154	2229	750	-273	-251	2455	-30	-207	-237	2172	280	-34	-101	2317	90	15	34	2456
96	IA-IL:DUBUQUE AREA	146	1529	515	-115	-75	1854	-23	-183	-206	1599	206	-30	-181	1595	62	-12	24	1669
97	IA:SPENCER (NW) AREA	77	903	304	-144	-2	1061	-13	-141	-154	885	114	-5	-38	956	37	12	11	1017
98	MN:WORTHINGTON (SE)	78	788	265	-156	-3	894	-11	-86	-97	776	100	-14	-55	806	31	9	-2	844
99	MI:JACKSON AREA	267	1774	597	29	-459	1941	-24	-142	-166	1716	221	6	-158	1784	70	-22	-13	1819
100	MT:GREAT FALLS AREA	51	1124	378	-156	-109	1236	-15	-93	-108	1127	145	-14	-259	1000	39	-4	106	1141
	30 Slowest-growing LMAs	96076	32337	-2900	-7888	102928	-1263	-7558	-8822	102025	13163	-638	-1997	112552	4396	-493	644	116899	4863

Source: Reynolds, Paul D. and Wilbur Maki. 1991. "U.S. Regional Characteristics that Promote Regional Growth". Final project report submitted to Aspen Institute Washington, DC in fulfillment of Ford Foundation Grant No. 890-013, University of Minnesota Grant No. 0610-5764, Minneapolis, MN.

Ranking total change in labor earnings in each LMA for the 1970-86 period confirms the unique role of the local base economy plays in regional job and income growth. For the 30 fastest-growing LMAs, total labor earnings increased from $182.6 billion in 1970 to $345 billion in 1986, as shown in Table 4.4. This is an increase of 89 percent. During the same period, total labor earnings increased for the 30 slowest-growing LMAs from $96.1 billion in 1970 to $116.9 billion in 1986. This is an increase of only 22 percent.

The direction of relative change is a distinguishing factor between the high income volatility and low income volatility LMAs as shown in Table 4.3. It is strongly negative for high volatility areas and strongly positive for low volatility areas. For most high income volatility LMAs, a positive regional-share effect for the 1970s turned negative in the 1980s, this contributed to the strongly negative relative change in the 1980s.

High levels of industry specialization in farming, mining or manufacturing distinguish the base economies of the high volatility LMAs. In these areas, the high income volatility correlates with a high degree of vulnerability to cyclically sensitive export markets. Extreme specialization of industry of the high income volatility LMAs persisted through the 1970s and part of the 1980s. Where high income volatility accompanied slow income growth, the local base economies faced shrinking export markets.

High income growth areas differ from high income volatility areas and low income growth areas in the diversity of their base economy. Even specialized base economies support high income growth when the export-producing sectors remain competitive. Generally, however, the specialized fast-growing economies lost their earlier momentum by the mid 1980s and faced, instead, much reduced income growth.

Northern Transportation Corridor. Of the two parts of the Northern Transportation Corridor, the Mid-Continent West accounted for about one-third of the total earnings in 1970. By 1986 the West accounted for 39 percent of this total. Thus, the Northern Transportation Corridor tilts sharply and symbolically to the West over the 1970-86 period. The automobile-based Michigan economy, for example, was out-performed by the air transportation-based economy of Washington. Moreover, the development of the energy resources of the West during this period added to its already rapid growth.

Historically, the two parts of the Northern Transportation Corridor experienced much income volatility due to the natural resource dependency of the interior states and the cyclically sensitive durable goods manufacturing elsewhere in the region. Historically, also, the individual states in this territorial aggregate trade much with Canada, particularly Ontario in the East and British Columbia in the West. Recent enactment of the US-Canada Free Trade Agreement further strengthens the already strong economic linkages between these long-time trading partners.

Shift-share model.[8] The shift-share model was used in this analysis to explain changes in a specific economic indicator, like total earnings. It partitions the period-to-period change in total labor earnings of a specific industry in an LMA into three parts--the national growth effect, the industry mix effect and the regional share effect, as shown in Table 4.2. Both the national-growth effect and the industry-mix effect pertain to US industry changes. Because of the general availability of US industry forecasts, any area can have its own forecast, given access to a forecast of the regional share effect.

Overall national growth affects all regions and all industries in proportion to the size of the industry. A negative change denotes a recession. A positive change denotes recovery in the general business cycle. Changes in industry mix represent the differential change (i.e., minus the change due to national growth) for a specific industry in the US. Cyclically sensitive industries present a high degree of variability as they shift from above-average to below-average production and earnings. When a product cycle changes over a short period, it too may result in a large industry-mix effect. Thus, the industry-mix effect reveals both short-term and long-term changes in the importance of individual industries in the US economy.

Changes in regional share -- the proportion of total US labor earnings in a specified industry originating in the given region--reveal changes in the competitive position of the region's industry. Each measure of regional growth varies in relative values from one period to the next. For some areas, the volatility in rates of regional growth is due to the cyclical sensitivity of the local economy. For other areas, the period-to-period changes in jobs and earnings relate to long-term changes in industry product cycles.

Shift-share analysis of selected labor market areas. Shift-share analysis identifies sources of income volatility--that is, period-to-period shifts in labor earnings. The summary results of the shift-share analyses show vastly different growth patterns.

The principal reasons for the contrasting growth patterns rest with the base economies in the Northwest Transportation Corridor. The competitive position of the Corridor's principal exports is worsening. This performance contrasts with an overall above-average industry-mix effect and an overall above-average regional-share effect in the base economies of the comparison region.

Economic Base, Business Volatility and Spatial Structure

Excess labor earnings, when used as a measure of the geographic concentration and specialization of industry, also defines the area economic base. It refers to the positive difference between a given area and the US in the percentage distribution of total labor earnings in a given industry. This positive difference is multiplied by the area's total industry earnings in deriving the area's excess labor earnings for the specified industry.

The shift-share model is an identity represented by the partitioning of the dependent into three parts, of which two are given to the regional analyst from the reference area data base and projection series.

A two-digit county-level wage and salary earnings series is the source of the excess earnings change variable. The US Department of Commerce statistical series provides this series for the following years: 1970, 1975, 1980, 1982, 1985 and 1986. Straight-line data interpolation of intervening year estimates completed the two-year even-year change series.

Figure 4.3 differentiates among LMAs in the US by new business formation. Findings of a related study (Reynolds and Maki, 1991) show a high correlation between new business formation and economic growth, especially in rural areas. This study shows, also, a high correlation between business volatility and economic growth. The working hypothesis for the related study focused on business volatility as an essential condition of a dynamic regional economy.[9] These earlier findings show the importance of business volatility in a region's economic growth. The authors note that, "The process of economic change requires a substantial transfer of resources (physical facilities, employees, entrepreneurial and managerial talent) from one firm to another, from one industry sector to another" (Reynolds and Maki, 1990, p.90).

Multiple regression models, estimated for each two-year period and three area orientations--rural (peripheral), manufacturing (rural transitional) and metropolitan (core), provide the empirical bases for this section of the report. Only estimates significant at 95 percent confidence level are presented. Total employment change is the dependent variable in each model. Figure 4.4 illustrates the economic base orientation of each LMA.

Employment effects of excess earnings. Most excess earnings variables correlate positively with employment change. Exceptions occur in the 1980-82 period and in construction, durable goods manufacturing and other services (health care, education and social services) that relate to their role in the 1980-82 recessions. In the preceding two-year period many LMAs peaked in total employment because of high levels of durable goods manufacturing in their local base economies. Large employment losses in the 1980-82 period followed peak employment levels in the 1978-80 period.

Agriculture sector earnings show the largest percentage change in total employment. On the other hand, the mining earnings-to-employment multiplier is large because of high earnings per worker in mining.

Employment effects of excess earnings in construction and other private services, like health care, education and social services, were largest in the urban metropolitan areas. Employment effects of excess earnings changes in the manufacturing sector and the transportation, communications and public utilities sector were large in LMAs with a manufacturing orientation.

Changes in the number of establishments and related jobs due to their establishment births and deaths, expansions and contractions define business volatility. This includes four variables--autonomous births and deaths and branch births and deaths--that represent firm volatility. Also, eight variables--the factorial combination of autonomous and branch, births and deaths, and expansions and contractions--represent job volatility. Business volatility is the composite of job volatility and firm volatility.

For the remaining industry groups the employment effects were largest in LMAs with a rural emphasis.

Employment effects of industry scale. Sector size relates positively to employment change in agriculture, construction, nondurables manufacturing, retail trade and other services. It relates negatively to employment change in mining, durable goods manufacturing, the transportation, communications and public utilities sector, and business services.

Current year values of excess earnings account for the differential effects of sector size on total employment in the regression model. Again, this measure of the base economy proved statistically significant in explaining model variance.

Employment effects of sector size vary with economic emphasis. They are the largest in (1) the urban metropolitan emphasis for retail trade and business services, (2) the rural emphasis for agriculture, construction, wholesale trade and other services, and (3) the manufacturing emphasis for mining, manufacturing, the transportation, communications and public utilities sector, and consumer services.

Employment effects of business volatility. Business volatility variables correlate positively with employment change, except for branch births and branch deaths in the 1982-84 period and job growth associated with branch births in the 1986-88 period. Autonomous firm births have the largest effect on total area employment.

Business volatility affects labor market areas with a rural emphasis more than LMAs with an urban metropolitan emphasis. LMAs with a rural emphasis experience more income volatility than LMAs with an urban metropolitan orientation. They also are more susceptible to the positive influences of increased business activity. One result of a concurrence of firm births and job expansions as well as firm deaths and job contractions is an economic dynamism that shifts local resources into more productive enterprises.

Thus, the business volatility effect is significant in most cases addressed in this study (Reynolds and Maki, 1991). It has the largest effect in rural areas that are defined as transitional, i.e., areas of above-average manufacturing industry growth. It is also significant in urban metropolitan areas with less income volatility than the transitional rural areas. The study findings have important policy implications that stem directly from economic principles, namely, that competitive markets allocate resources to their "best" uses, but only because entrepreneurial capital exists to accomplish a shift of local resources to more profitable uses.

Most regional growth models fail to include such measures of firm structure when fitted to available data, simply because of the lack of data. In this study (Reynolds and Maki, 1991), access to the firm-level Duns Marketing Indicators for a two-digit classification of industry groups covering 3,124 counties in the US over six two-year periods provided a unique opportunity for testing a series of hypotheses relating to the contribution of firm structure and change to regional economic growth.

The findings on the importance of business volatility in accounting for regional growth complement the findings based on the shift-share model. They provide additional geographical attributes of regional change not included in a set of partitioned change variables, as in the shift-share model. In this paper, they confirm the impressions of many observers of rural economies that "all rural areas are not same". Each rural area has its unique "index of peripherality", represented in part by its business volatility measures.

Other variables in the regression model also complement the shift-share findings. These include two measures of change in excess earnings as measures of an area's economic base change and four measures of spatial structure.

Employment effects of spatial structure. Three dummy variables represent market access differences in the spatial structure of rural and metropolitan areas. Market access, as represented by proximity to one or two of the 29 US airline nodes, is a statistically significant locational attribute for differentiating among LMAs with reference to employment change. It helps articulate the role and dimensions of location, particularly about metropolitan core areas, in regional economic growth and change.

Each of the three economic orientations cited earlier has a different response to the market access variables. Proximity to a primary and secondary airline node correlates positively with employment change, especially for the LMAs with a rural orientation. Proximity to two airline nodes is most important to LMAs with a metropolitan orientation.

Access variables, like distance to nearest airport node or proximity to nearest metropolitan core area, provide additional measures of rural-to-metropolitan area linkages. They serve as a surrogate measure of access to information and markets for high value added products and to growth-facilitating business distribution services in the metropolitan core areas.

A Sunbelt location was a positive factor in employment growth in the 1978-80 and 1980-82 periods, but a negative factor in the 1984-86 and 1986-88 periods. The LMAs with a metropolitan orientation were slightly more influenced by these factors than the combined LMAs.

Population density was a negative factor for LMAs with a manufacturing orientation during the 1980-82 period, but a positive factor in the 1984-86 period. It was a positive factor for LMAs with a rural orientation in the 1978-80 period when rural prosperity was approaching its peak period in the Northern Transportation Corridor Region.

Finally, total personal income change correlates positively with employment change in the 1984-86 and 1986-88 periods and negatively in the 1978-80 period. Its largest effect was in the LMAs with a manufacturing orientation.

5. POLICY IMPLICATIONS OF CHANGING LOCAL ECONOMIC STRUCTURE

Spatial-Economic Determinants of the Demand for Transportation

One interpretation of the study findings is that a particular region's location imposes severe constraints on regional development options. A rural LMA located well beyond the outer commuting limits of any metropolitan LMA has diminished prospects for long-term economic viability beyond the lifetimes of its principal product cycles. These are some tentative conclusions from comparisons of the contrasting labor earnings and employment experience of selected core versus selected peripheral labor market areas in the US.

Contrasting core and peripheral labor market area. A series of statements contrasting the two types of areas--core and periphery--summarizes the principal findings of the two studies cited earlier. The study findings (Maki and Reynolds, 1991) show for the 5 two-year periods from 1978-80 to 1986-88 that:

1. Slow-growing labor market areas (LMAs) are not consistently slow-growing and fast growing LMAs are not consistently fast growing. However, slow-growing areas in total are consistently slow growing and the fast-growing areas in total are consistently fast growing in each of three time periods.

2. Slow-growing areas experience both a negative industry effect and a negative regional share effect during each of the three time periods. Fast-growing areas experience both negative and positive industry mix effects and generally positive regional share effects.

3. Slow-growing areas are concentrated in the sparsely populated parts of the study region while fast-growing areas are concentrated in and around metropolitan core areas.

4. Exceptional shifts in the commodity-producing sectors accounts for high income volatility among LMAs while low volatility areas generally maintain their diverse base economy.

5. Rural areas with some exceptions retain high levels of industry specialization, while metropolitan areas generally sustain their diversified base economies.

6. High business (not income) volatility is associated with high growth and low business volatility is associated with low growth.

7. Access to, and choice of, airline node is associated with high growth.

8. Sunbelt location is associated with high growth much of the time but low growth when the product cycles of dominant basic industries a strongly negative industry-mix effect.

In summary, the peripheral LMAs are most vulnerable to cyclically induced income volatility while metropolitan core areas benefit most from business volatility. Transitional rural areas experience high income and business volatility and, also, high income growth.

Attributes of local economic environment. The study findings presented earlier show a high degree of industry specialization in most LMAs, especially among those with the highest income volatility. The incidence of specialization has not changed among individual LMAs with the highest income volatility.

Overall, reduced dependence on agricultural specialization among the 100 selected LMAs balances increased dependence on manufacturing specialization. Until the 1982-84 period, mining specialization also was important. For most LMAs with a rural or manufacturing orientation, replacement of extreme dependence on industry specialization with a more diverse base economy seems unlikely, given the factual evidence presented earlier.

Thus, the recent history shows that:

1. Peripheral rural LMAs are overwhelmingly dependent on the utilization of local natural resources. Efficiency in the conversion of primary resources into finished products reduces the demand for primary products and places many peripheral areas at risk. Often cited, also, but less evident, is the decoupling of advanced manufacturing from primary production. In any event, advanced manufacturing clearly is skill-dependent, which favors industry location in core metropolitan areas and adjoining rural areas and in new industrial spaces in formerly peripheral areas now anchored to cities that serve as small scale metropolitan core areas.

2. Transitional LMAs are exceptions to the overall pattern of continuing industry specialization. They are close enough to the metropolitan core area to gain new industry, particularly new businesses of industries branching from the metropolitan core area to low cost sites in nearby rural areas. Also, a new, diverse base economy is emerging in the transitional LMAs because of metropolitan core area businesses subcontracting with transitional area businesses. Thus, transitional rural areas experience high income growth and high income volatility and, also, high business volatility.

3. Metropolitan LMAs, with the exception of areas marked by negative industry mix and regional share values in a highly specialized base economy, generally are the fastest growing in labor earnings. At the same time, income volatility may range from the lowest to among the highest LMAs. A high degree of dependency on a specialized base economy would still sustain high income growth as shown

by the strongly positive industry mix and regional share effects. Business volatility is generally high in metropolitan areas.

Peripheral LMAs dominate the standardized and readily tradeable products cluster. Metropolitan LMAs dominate the non-standardized less readily tradable products cluster. Successful strategies for maintaining and improving on existing business locations, products and technologies thus differ for the two types of industry clusters.

The realities of business location, industry product cycles and access to new product and process technologies are constraining influences on regional growth. An important attribute of an optimal location for a business enterprise is the local infrastructure--the physical facilities and economic resources shared, in varying degree, by all local businesses (Aschauer, 1991; Porter, 1990).

For the most part, the local infrastructure is in the public sector, although it includes important quasi-private and private enterprise. The local infrastructure includes the regulated industries -- transportation, communications and public utilities -- as well as banking, finance and insurance companies, management consulting agencies, and research and development laboratories (Moss and Brion, 1991; Noyelle and Stanbeck, 1984).

Each industry cluster in a local community shares the total local infrastructure. By definition, the export-producing businesses are part of the local base economy. Typically, the largest employers in this category are branch plants or headquarters offices of multi-national companies trading in global markets (Daly, 1991). Corporate decisions based on national and global rather than local considerations particularly affect branch plants. The quality and availability of local training and education in public schools and post-secondary educational institutions also affect the productivity of the local work force.

The location attribute for strengthening a region's economic base includes support industries serving the region's residentiary sector and the local transportation and telecommunications infrastructure. Local governmental efforts and the local macro-economic environment directly affect both supporting industries and local infrastructure.

Improving access to decision information by the residents of a region is of over-riding importance in building local infrastructure or supporting the base economy. However, available local resources limit access to information by local community leaders and resident small business managers. The decision centers of the large corporations with branch plants and offices in the local community have the information access advantage.

Small export-producing businesses in peripheral areas may access markets through various contractual arrangements with core area businesses. These include outsourcing by core area producers during peak production periods and promotion of training sessions sponsored by core area producers for input-supplying businesses. New public-private partnerships address the advantages of cooperation between rural and metropolitan area businesses and institutions in

strengthening local and regional infrastructure and support industries for interregional and global competition.

Key sectors for improving local access to information include state and local educational institutions and related community functions, such as city and neighborhood libraries and social centers. Moreover, various information partnerships that involve local businesses and community leaders, as well as state and local governments, can become active participants in improving access to decision information. For example, local and regional post-secondary educational institutions with curricula and programs that address periphery-to-core area linkages and information access may thus contribute directly to improving the quality of life and the economic well-being of local and regional residents. For many of these institutions, however, a radical change in the attitudes and values of its members and providers may be necessary to redefine the "business" of "higher" education to include these sorts of local missions.

Institutional Factors Affecting Current Demand for Transportation

Institutional factors account for much of the current difficulties in optimizing public and private investment in transportation infrastructure. The institutional factors include (1) state and local subsidy of exurban infrastructure and federal tax expenditures (i.e., deduction of interest payments on home mortgages) for residential housing, (2) exclusionary use of subdivision and zoning regulations, (3) public subsidy of long-haul trucking, (4) restrictive rules and practices of railroads, and (5) long-standing politicalization of federal public works programs and spending. These intrusions into land use decision processes at the local level result in inequitable and inefficient land uses that add measurably to transportation costs and, in turn, to the private and public costs of urban infrastructure and related services. The "crisis of the cities" is, in large part, the result of these policies.

Public subsidy of exurban infrastructure and private housing. Public subsidy of access roads and highways to the expanding urban periphery of metropolitan areas invited "leap frog" residential development that resulted in costly urban sprawl. Growing separation of place of residence from place of work also added to costs of local transportation that, in large part, became a public cost.

The Twin Cities Metropolitan Council and the Citizens League of the Twin Cities in Minnesota and similar organizations throughout the U.S. addressed concerns about the high costs of urban sprawl in the 1960s and 1970s. A Citizens League study found strong support for containing urban development in the Twin Cities (of Minneapolis and St. Paul) Metropolitan region. These and later findings, including the exhaustive studies of the Real Estate Research Corporation and the Department of Housing and Urban Development help identify and understand the importance of targeting public spending to reduce the high costs of urban sprawl.

The Citizens League report addressed the topic: "How the Twin Cities area can provide amenity in housing without an unnecessary increase in costs of urban services or damage to the environment." The report noted that "sprawl is the most complex of all urban problems. It goes

to the heart of what local governments do and to the heart of private enterprise in housing and development and the private ownership of land."

This report cites numerous serious consequences of urban sprawl that affect people who live within the built-up urban area and their local environment. These include:

> A. More costly public and private facilities and services...to serve new fringe area development at a time when there is excess capacity or inefficient use made of existing capital investments within the built-up area.
>
> B. Many of the public facilities and services on the fringe are paid for not only by the new residents but also by people who live in the built-up areas. Yet these existing residents have practically no voice in how development occurs.
>
> C. Fringe area development which will result in the loss of valuable open space and eventual surface and ground water pollution in many areas will exact a high cost to the environment of the region."

This report supports a new strategy: "an alternative form of housing on land inside the fringe with the amenities, privacy, and lower cost many are seeking outside of it."

James Hoben, program manager for land use research, HUD Office of Policy Development and Research, reports on the cost of sprawl study, which he jointly directed with Edwin Clark of the Council of Environmental Quality and Cheryl Wasserman of the Environmental Protection Agency. This study found that:

> 1. Total capital investment costs for the higher density community are 44 percent less than those for the lower density community;
>
> 2. Energy consumption is 44 percent less for the higher density clustered community, air pollution is 45 percent less, with pollution from automobiles 20 to 30 percent less;
>
> 3. Personal time costs were less in the higher density development with less time involved for traveling to schools, jobs and shops.

Thus economic and environmental considerations, as well as opportunity costs, strongly support the containment of urban sprawl.

Exclusionary use of zoning and subdivision controls. In 1926, the U.S. Supreme Court gave states complete power to establish any land use controls they wanted. These powers included zoning regulations, subdivision controls, municipal growth management and land development fees. Thus, legal opinion protects the exclusionary uses of large lot sizes and open space preserves.

Large lot size and open space requirements favor the construction of high-income housing in the open country. Central cities and the first ring of suburbs are left with the low-income housing, but without the tax base to support the high cost of providing social and economic services for those left behind. Those who have the money to buy large lots and build expensive housing can move away from the problems of the central city and first ring suburbs and at the same time reduce their municipal taxes and mortgage interest payments by one-half or more.

Two serious consequences (apart from its outright unfairness) flow from the exclusionary land use controls, namely, the inability of local governments to work for the common good and the proliferation of subsidized shopping centers that simply redistribute the total spending of the metropolitan region, but add to its total transportation costs--public and private. No municipality can bribe another, for example, to locate its land fill in the other municipality. Nor will any suburban municipality readily allow the location of a job-creating facility within its boundaries that serves the entire metropolitan area. Thus, total jobs available to the central city and first-ring suburban residents are reduced by the exclusionary practices.

Maintenance and re-enforcement of the separation of place of work and place of residence imposes large private and social costs in maintaining the urban metropolitan infrastructure. Much of the available financial resources of state and local governments are absorbed by the transportation infrastructure for serving new shopping centers. Not only is the total transportation bill higher, but the environmental costs also increase because of the readily available public financing of local transportation infrastructure.

Public subsidy of long-haul trucking. Long established documentation of the high public costs of highway construction and maintenance resulting from long-haul trucking has had only minimal influence on the taxes paid by long-haul truckers. This is not the fault of the trucking industry but of the legislative bodies and the voting constituencies that support them. Disassociation of the benefits and costs of long-haul trucking also adds to total transportation bill.

Restrictive rules and practices of railroads. One important reason for the excessive dependence on publicly subsidized long haul trucking is the total inadequacy of the existing rail transportation system to serve the public interest. Restrictive labor practices, coupled with poor management, insure the demise of rail transportation. Now more than ever before the airline and trucking transportation industries benefit from multi-modal approaches to the transportation systems management.

Transportation expenditures and the electoral process. Public works spending is an incumbent's way of assuring incumbency. No wonder that legislators favor massive increases in transportation infrastructure spending. They tend generally to follow the electoral cycle( ).

Productivity-Increasing Factors Affecting Future Demand for Transportation

Closer scrutiny of all public infrastructure spending, together with increasing public pressures to reduce government spending in the future, puts a premium on productivity improvements in the construction and use of transportation infrastructure. More precise economic

analysis of the cost-effectiveness of specific infrastructure investments may lead to alternative investments in productivity enhancement.

These potential savings include: 1) reducing travel time from place of residence to place of work and shopping centers; 2) increasing the efficiency of personal transportation; 3) increasing the energy efficiency of the transportation vehicle; and 4) increasing the efficiency of commodity shipments through the use of new technologies.

1) Reducing travel time to work and shopping. Personal expenditures account for two-thirds of the total transportation bill. These expenditures could be significantly reduced by revisiting the legality of exclusionary land use practices, and through the development of land use plans that discourage urban sprawl. Denser cities consume one-fourth as much fuel as less dense cities (Newman and Kenworthy, 1989). Also travel related energy consumption is 8 to 14 percent less in planned developments than in unplanned developments (Real Estate Research Corporation, 1974).

Travel times can also be reduced through economic incentives that reduce congestion. Several studies have pointed out the enormous potential savings from reduced congestion. These savings accrue from both reduced fuel consumption and the value of people's time spent waiting in traffic. It is estimated that congestion costs the nation's economy 73 billion dollars per year, or 2 percent of GNP (Rowland, 1989). Also according to the FHWA congestion costs commercial shippers between $19 and $23 billion a year (GAO, 1989a).

2) Increasing efficiency of personal transportation. Alternative means of travel to work and shopping are feasible with existing urban land use control. They become even more feasible with the revamping of existing land use controls. In the U.S, only 15% of urban trips are made by mass transit, bike, or on foot, while in Europe over 50% of urban trips are made by these alternative modes of transport (Burwell, 1991).

3) Increasing the energy efficiency of the transportation vehicle. By increasing the energy efficiency of the cars, trucks, trains, barges and airplanes, the total transportation bill can be significantly reduced. It is estimated that new car fuel efficiency could be raised to 44 MPG by the year 2000, at a cost of only 57 cents per gallon of gas saved (Gordon 1991). "On a national scale, an increase of new car fuel economy to 44 MPG by 2000 would reduce U.S. highway-transportation fuel consumption by about one million barrels a day" (Ledbetter and Ross, 1990). At the current price of 24 dollars per barrel of oil this represents a potential saving of 876 billion dollars a year.

Similar savings are possible for heavy duty trucks, aircraft, and trains. Carlsmith estimates that "heavy duty trucks could make efficiency gains of 20 percent in the next 30 years (Carlsmith et. al., 1990). While NASA has set a near-term fuel economy goal of reducing commercial aircraft fuel consumption by 20-30% (Green, 1989). Finally, railroads offer potential fuel savings in two ways. First as additional freight is shipped by rail, fuel is saved because rail is four times as fuel efficient as trucks (Gordon, 1991). Secondly, the development of Maglev

trains has the potential of saving 280,000 barrels of oil a day in highly traveled corridors (Carlson et. al., 1990).

4) Increasing the efficiency of commodity shipments through the use of new technologies. The use of double-stack containers on trains and trucks can cut fuel use by 35% and operating costs by 40%, and offer faster transit times than previous systems (Nicholas, 1989). Also the use of IVHS (intelligent vehicle highway systems) offer the potential of increasing highway capacity by 10-20% (OTA, 1989b). Also, a study done by the Midwest Transportation Center found that truckers pay 6.4 billion dollars a year in compliance costs that could be avoided through investments in technologies that promote transparent borders (Maze and Maggio, 1992). Finally, the use of new data management technologies such as electronic data interchanges (EDI) will allow for greater freight consolidation and increase the productivity of commodity movements (Muller, 1990).

Cost-effective public expenditures for transportation infrastructure. Shifting the allocation of public spending for transportation infrastructure from a public works for re-electing incumbents basis to a demand-based efficiency targeting of these expenditures reduces the total transportation bill. Included among related changes in the targeting of transportation-related spending is the adoption of "zero maintenance" strategies. Such strategies would gradually bring the transportation spending, particularly in declining areas, in line with present and projected use of the transportation infrastructure.

Estimates of the potential cost savings are clouded by lack of criteria for evaluating business and personal transportation requirements under several future scenarios. It is estimated, on the basis of currently available data, that these costs are more than two percent of gross domestic product. This converts to yearly savings of more than $100 billion.

Thus, total transportation cost savings associated with the various transportation cost-reducing measures could exceed $380 billion--an amount equivalent to roughly seven percent of gross domestic product. This does not imply, however, that the total transportation bill is reduced by the same amount. Rather, the savings would result in improved transportation facilities and services and in part in an improved environment for local business enterprise and an improved quality of life for local residents.

6. SUMMARY AND CONCLUSIONS

The study objectives are to (1) document changes in the economic base and related economic activity of individual labor market areas and states in the Upper Midwest, (2) analyze the linkages between these measures of local economic structure and transportation infrastructure expenditures, and (3) present alternative scenarios of local economic change and their implications for transportation systems policy and planning in Minnesota and the Upper Midwest states. Economic base theory provides the underlying rationale for the analytical framework of this study.

Economic base is basic. Peripheral areas--the sparsely populated labor market areas producing largely standardized, tradable agricultural, mineral and timber products--benefit from export growth. However, the economic and political importance of these products and their areas of production has declined in recent years because of reduced requirement for energy and other material inputs.

Earnings per worker are high in metropolitan core regions. Investment per worker is also high in the metropolitan core areas. Yet, the two contrasting types of regions are interdependent local economies. Business volatility is positively, rather than negatively, associated with economic growth.

Business volatility correlates with employment change. Changes in the number of firms and related jobs due to establishment births and deaths and job expansions and contractions define business volatility. Four variables--autonomous births and deaths and branch births and deaths--represent firm volatility. Eight variables--the factorial combination of autonomous and branch, births and deaths, and expansions and contractions--represent job volatility.

Business volatility variables correlate positively with employment change in the studies addressed in this report, except for branch births and branch deaths in the 1982-84 period and job growth associated with branch births in the 1986-88 period. Autonomous firm births consistently have the largest effect on total area employment.

Business volatility affects labor market areas with a rural emphasis more strongly than LMAs with an urban metropolitan emphasis, particularly about autonomous births and autonomous expansions. While LMAs with a rural emphasis may experience more income volatility than LMAs with an urban metropolitan orientation, they also are more susceptible to the positive influences of increased business activity. One result of a concurrence in firm births and job expansions as well as firm deaths and job contractions is an economic dynamism that shifts local resources into more productive enterprises.

Market access makes a difference. Market access as represented by proximity to one or two of the 29 US airline nodes is a statistically significant locational attribute for differentiating among LMAs. It helps articulate the role and dimensions of location in regional economic growth and change.

Each of the three economic orientations cited earlier has a different response to the market access variables. Proximity to primary and secondary airline nodes correlates positively with employment change, especially for the LMAs with a rural orientation. Proximity to two airline nodes is most important to LMAs with a metropolitan orientation.

Location affects long-term economic viability. One interpretation of the study findings addressed in this report is that a particular region's location in the national and global regional settlement and trading systems imposes severe constraints on regional development options. A rural LMA located well beyond the outer limits of any metropolitan LMA has diminished prospects for long-term economic viability because of reduced access to vital business and market information. Such an area lacks the economic and political power to seriously affect the decision options of the largest export-producing businesses.

At best peripheral areas face a gradual decline in economic and social well-being. The decoupling of primary production from advanced manufacturing systems will lead to radical change in the spatial-economic organization of regional activity systems. Peripheral areas of metropolitan-focused regions thus sooner, rather than later, become the parks, playgrounds and ecological preserves for an environmentally conscious, dominantly urban population.

New industrial spaces link peripheral to core areas. An alternative interpretation of the study findings is that peripheral areas of metropolitan-focused regions are, in large numbers, transitory. Those close to metropolitan core areas experience the overspill effects of rapid population growth in the core area. A new locational equilibrium for manufacturing enterprise, driven by lower site and production costs, transforms many rural communities into the expanding urban frontier of the metropolitan core area (Scott, 1988).

The new industrial spaces emerge initially in rural areas adjoining the metropolitan core area. They expand gradually into the more distant areas within 100 miles or so of the core area borders.

For distances beyond 100 miles in the rural periphery, cities of 100 thousand or more attract new industries seeking low cost sites and access to the "knowledge workers" and information sources at local post-secondary education institutions and libraries. Such a city is Fargo, North Dakota, together with the adjoining city of Moorhead, Minnesota..

The metropolitan core area of a radically transforming economic region remains an integral link in the global transportation and communication network (Irwin and Kasarda, 1991). However, it, too, faces internal change. Its downtown district is rapidly becoming the "nerve center" of the extended economic region with a concentration of strategic management services (Daly, 1991; Daniels, 1991; Moss and Brion, 1991). Air transportation and telecommunications systems connect the downtown with clients and customers on virtually a real time basis, globally as well as locally and regionally.

Yet, one-on-one relationships among information providers and users are even more important in the downtown district than ever before because of the uniqueness of information--its

principal product--and its inherently differentiated content (Hutton and Ley, 1987; Ley and Hutton, 1987). The downtown district thus transforms into a locally-connected global information center by its strategic management functions and supporting infrastructure and services (Daly, 1991; Daniels, 1991; Leo and Philippe, 1991; Noyelle and Peace, 1991).

Rural service centers. New rural service centers link rural residents to core area information sources. Even declining rural labor market areas include individual counties experiencing job growth. These are counties marked by the existence of a growing area service center in each county that provides the high order services for the entire labor market area. The area centers typically have one or more post-secondary education institutions and a municipal or county public library system. They also have numerous public and private linkages with government agencies and businesses in the metropolitan core area.

Key players in the new "connectivity" games that link metropolitan and peripheral areas are the "knowledge workers." Although primarily metropolitan "downtown" residents, they reside throughout the peripheral areas of the metropolitan-focused economic region. "Knowledge workers" reside in every rural and urban population center with public libraries and post-secondary educational institutions. They serve as information specialists and managers of information resource offices and systems. University extension offices and post-secondary education institutions, particularly, could cater to the information needs of local residents--households, businesses and government agencies--if this were part of their mission. However, additional training and experience are essential (like the three year apprenticeships now offered by one "high-tech" management consulting firm in the Minneapolis-St. Paul Metropolitan Area) for "knowledge workers" generally to become fully contributing members of this new profession.

Implications of changing local structures. Past changes in the economic of local labor market areas documented in this study point to the importance of institutional factors affecting the demand for transportation. Projected changes in the Upper Midwest and the Northern Transportation Corridor continue with the historical trends among most labor market areas. Peripheral areas continue their decline while metropolitan core areas face similar prospects in the their central cities and first ring suburbs. For the most part, growth in population and related personal transportation is concentrated in the transitional areas within 100 miles of the metropolitan core areas.

Thus, productivity-increasing measures that improve the delivery and use of transportation infrastructure and related services are presented as the first order of business for a transportation research agenda.

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Appendix

BEA REGIONS WITHIN THE 5-STATE UPPER MIDWEST STUDY AREA

North Dakota

149 Fargo-Moorhead
150 Grand Forks
151 Bismarck
152 Minot

South Dakota

146 Rapid City
147 Sioux Falls
148 Aberdeen

Minnesota

95 Duluth
96 Minneapolis-St. Paul
97 Rochester

Wisconsin

89 Milwaukee
90 Madison
91 LaCrosse
92 Eau Claire
93 Wausau
94 Appleton-Green Bay

Iowa

98 Dubuque
99 Davenport
100 Cedar Rapids
101 Waterloo
102 Fort Dodge
103 Sioux City
104 Des Moines

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MINNESOTA COUNTIES BY BEA REGION

BEA 91	BEA 92	BEA 95	BEA 96	BEA 97	BEA 147	BEA 149	BEA 150
Houston	Burnet	Carlton	Aitkin	Dodge	Lincoln	Becker	Clearwater
Winona	Pierce	Cook	Becker	Fillmore	Lyon	Clay	Hubbard
	Polk	Itasca	Benton	Freeborn	Murray	Manhomen	Kittson
	St. Croix	Koochiching	Big Stone	Mower	Nobles	Norman	Lake o'Woods
		Lake	Blue Earth	Olmsted	Pipestone	Otter Tail	Marshall
		St. Louis	Brown	Steel	Redwood	Wilkin	Pennington
			Carver	Wabasha	Rock		Polk
			Cass				Red Lake
			Crow Wing				Rouseau
			Dakota				
			Douglas				
			Faribault				
			Goodhue				
			Grant				
			Hennepin				
			Isanti				
			Kanabec				
			Kandiohi				
			Laq Parle				
			Le Sueur				
			Martin				
			McCleod				
			Mercer				
			Mille Lac				
			Morrison				
			Nicollet				
			Pine				
			Pope				
			Ramsey				
			Renville				
			Rice				
			Scott				
			Sherburne				
			Sibley				
			Stearns				
			Stevens				
			Swift				
			Todd				
			Todd				
			Traverse				
			Wadena				
			Waseca				
			Washington				
			Watonwan				
			Wright				
			Yellow Med				