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THE CHANGING STRUCTURE OF THE TRANSPORTATION SECTOR

AN INPUT-OUTPUT ANALYSIS

by

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*Anwar Hussain, Wilbur Maki, Doug Olson, David Braslau**

Introduction

Developed economies of the world are going through another level of transformation: the transition from manufacturing to a service economy. Robert Summers[1] reports that approximately 50 percent of all U.S. expenditures on its gross domestic product in 1975 were spent on services up from about 46 percent in 1970. According to Inman[2], in the U.S. the share of services in non-farm employment has risen from nearly 50 percent in 1952 to just under 68 percent in 1981. In the same vein of thought, Blair and Wychoff[3] find that during 1972-1982, the share of GNP for natural resource intensive and manufacturing industries that pay high wages experienced substantial reductions while the share of GNP for service, substantial increases. A very clear picture, however, is brought out by Norsworthy and Jang[4] who, based on survey of current business, report that: "The contribution of the service producing sector to gross domestic products in the U.S. increased from 53.5 percent in 1950 to 71.7 percent in 1988, while the goods-producing sector declined from 46.5

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[1] *Robert Summers, Services in the International Economy in (ed) Robert P. Inman, "Managing the Service Economy: Prospects and Problems," Cambridge Univ. Press, 1985, p.27.*

[2] *Inman, Robert P., Introduction and Overview, in (ed) Robert P. Inman, op. cit., p.1.*

[3] *Blair, Peter and Andrew Wychoff, The Changing Structure of U.S. Economy: An Input-Output Analysis, in (eds) Miller, Ronald et al., "Frontiers of Input-Output Analysis," Oxford University Press, NY 1989, p. 293.*

[4] *Norsworthy, J.R., and S.L. Jang, "Empirical Measurement and Analysis of Productivity and Technology Change: Applications in High-Technology and Service Industries," North-Holland, New York 1992, p. 195.*

percent to 28.3 percent. In 1988, the gross domestic products from the service-producing sector was 2826.7 billion dollars much higher than 1116.7 billion dollars for good-producing sector." Besides its deep and fundamental implications for the economy and structural change, this process is accompanied with a host of new issues to consider. Particularly, this transformation implies understanding at two different levels viz; i) The upward shift of service sector viz-a-vis the rest of the sectors such as manufacturing, agriculture, etc.; ii) The relative shifts occurring within the services sector itself. The focus of this paper is the latter in a limited sense. Specifically, we attempt to look into the transportation sector—a component of the Services sector[5]—in the USA and the state of Minnesota with the following objectives in mind: i) What are the key characteristics of this sub-sector of Service sector; ii) Where does the demand for its output originate; iii) What sort of linkages characterize this sector of the economy; and iv) What are the changes, if any, in employment levels and how do we account for them.

The paper is organized under four headings viz; i) Description of the Database in general and Issues Specific to the Transportation Sector; ii) General Characteristics of the Transportation Sector; iii) Inter-industry Linkages, and iv) Employment Growth Performance. At the end we give a few qualifying remarks about the data and a summary of the main findings.

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[5] *For a taxonomy of service industries, see Baumol, Phillip J., Productivity Policy and the Service Sector, in (ed) Robert P. Inman, op.cit., pp. 301-317.*

I. Description of the Database and Issues Specific to the Transportation Sector

The data for this paper comes from the different Micro IMPLAN[6] databases for 1982, 1985 and 1990.[7] IMPLAN operational capabilities as an input-output and impact analysis tool are used to obtain the key components of input-output accounts pertaining to the transport sector. Specifically the following industries, making up the transportation sector, are investigated:

IMPLAN Nos.		*SIC-Code*	Title
1990	1985/82		
446	435	40	Railroads and related industries
447	436	41	Local/inter-urban passenger travel
448	437	42	Motor freight and warehousing
449	438	44	Water transportation
450	439	45	Air transportation
451	440	46	Pipeline except natural gas
452-53	441-42	47	Transportation services

The IMPLAN database consists of 20 economic and demographic variables at a 528 industrial sector level for all counties in the United States. The database is built from the county level up and the national level down. The data come from a multitude of sources, and in many cases are estimated. The IMPLAN database and software provides the information and capability to estimate a complete set of social accounts for a given area[8] in

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[6] *Micro IMPLAN—Impact analysis for Planning—is a microcomputer program that performs regional input-output analysis. This program has been in existence since 1979 and has evolved from a mainframe non-interactive application that ran in batch mode to a menu-driven microcomputer program. Using the program, a model can be defined for any region in the United States using secondary—though not limited to—data which are available by state and county with the latter as the smallest unit of measure. Once a regional model is generated, impact analysis can be performed by introducing shocks to see the impact on critical economic variables of the regional economy.*

[7] *Regarding the construction, sources and other details of 1985/1990 databases see: Lindall, Scott and Doug Olson, Micro IMPLAN 1990/1985 Database Documentation, University of Minnesota, May 1993. Details of the 1982 database are given in: Gregory S. Alward, IMPLAN Version 2.0: Methods Used to Construct the 1982 Regional Economic Data Base, General Technical Report RM-000, USDA Forest Service.*

[8] *This could be a county, group of counties, state, group of states or the nation as a whole depending on how the model is defined. IMPLAN allows for all of these possibilities.*

the USA. These social accounts (rectangular use/make accounting format) are then converted to (industry by industry format) input-output accounts.

With regard to the technology of production, the 1990 IMPLAN database draws on the U.S. Department of Commerce 1982 U.S. Benchmark Input-Output Model[9] while the 1985 and 1982 databases draw on the 1977 U.S. Benchmark Input-Output Model. The benchmark technology figures were price updated and RASed[10] to current U.S. National Income and Product Accounts (NIPA) control values for each of the respective database years viz; 1990, 1985 and 1982.

IMPLAN follows standard I/O convention in treating the transportation industries as margined industries.[11] The margins implied in the 1977 & 1982 BEA benchmark tables are therefore carried through to the structural matrices created for the regional IMPLAN models. Thus to the extent there has been real productivity change in the transportation industries over the period, transportation output figures derived through IMPLAN are going to be biased up or down depending upon the nature of the productivity change in the sector.

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[9] *U.S. Department of Commerce, BEA, The 1982 Benchmark Input-Output Accounts of the United States, Washington, DC, 1991.*

[10] *This is a partial-survey iterative procedure for estimating an input-output matrix starting from a reference matrix when the row and the column totals of the transaction matrix for the projection period are known. To express the goodness of fit of an input-output table generated by RAS see, Szyrmer, Janusz, Trade-off Between Error and Information in the RAS Procedure in (eds) Miller, Ronald, op. cit., pp: 258-278.*

[11] *For detail description of these margins see Lindall, Scott and Doug Olson op cit, p.6. For the theoretical underpening of margins and the related notions of f.o.b. and purchaser's prices see Bulmer-Thomas V, "Input-Output Analysis in Developing Countries: Sources, Methods and Applications," John Wiley & Sons Ltd., NY 1982, Chap. 6, pp. 86-100. For some of the conceptual and empirical problems generally associated with transport service sector of a regional economy see Bourque, Phillip, "Estimating Regional Transport Inputs by Using Sectors," A discussion paper presented at the Western Regional Science Association Meetings, San Diego, Feb. 1989, p.3-5. For an analytic framework in this regard see Amos, Ilan et al., "The Treatment of Foreign and Domestic Transportation in Regional Input-Output Modelling," in (eds) Dutta, Hartline and Loeb, "Essays in Regional Economic Studies," The Acorn Press, NC, 1983.*

II. Characteristics of the Transportation Sector

II.1 Gross Output (GNP) And Its Distribution

In IMPLAN gross commodity output is distributed across intermediate and final demand. While intermediate demand may have its source in either or all of IMPLAN 528 sectors, the final demand originates in:

i. Households-disaggregated further into low, medium and high as:

		1982 Data	1985 Data	1990 Data
Low	Ann. HH Income under	$10,000	$15,000	$20,000
Medium	Ann. HH Income between	$10-30,000	$15-40,000	$20-40,000
High	Ann. HH Income greater	$30,000	$40,000	$40,000

ii. Government sector-disaggregated into local/state and federal activities. The state and federal activities are further disaggregated respectively into educational/non-educational and military/non-military components.

iii. The other sources of final demand are:

- Exports - domestic as well as foreign
- Commodity Credit Corporation (CCC)
- Inventory addition
- Capital formation

For a given sector 'i', the disposition of gross commodity output may be written as:

$$x_i = \sum_{j=1}^{m} x_{ij} + \sum_{d=1}^{n} X_{id} \quad i, j = 1 \ldots m$$

where x_{ij} = commodity intermediate demand, i.e. sale of commodity i to industry j;

X_{id} = sale of commodity i to final demand category d, d = 1...n;

x_i = gross output of sector i. i = 1...m

II.2.i. *Gross Commodity Output Level*

Judged on the basis of gross commodity output, air and motor freight industries dominate the transportation sector both at the state level—Minnesota in this study—as well as at the national level. The overall situation has, however, been changing since 1982. Thus, while air and motor freight continue to have the same strong position, railroads and water transportation industries have been losing their relative shares of gross commodity output. We observe that while in 1982, gross output in the railroad industry was 14% of the whole transportation sector, in 1990 its share fell to 9.01%. Likewise, the share of water transportation fell from 16.45% in 1982 to 6.83% in 1990. Another important change that occurred over the period 1982-1990 is that transport service industry, both at the regional as well as national level, gained share in output levels. This has happened because of the higher than average annual growth rate for this industry over the period 1982-1990. A summary of IMPLAN estimates is given below:

Table 1: Transportation Sector Industries Distinguished by Percentage Distribution of Gross Output (in 1990 million dollars)

Region/ Year	Transportation Industry							
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services	
	40	41	42	44	45	46	47	Aggregate
MN								
1982	*21.35*	*6.15*	*29.04*	*4.51*	*33.99*	*2.89*	*2.07*	*100.00*
1985	*14.70*	*5.25*	*39.35*	*4.73*	*31.16*	*1.64*	*3.17*	*100.00*
1990	*10.73*	*6.27*	*38.09*	*1.99*	*35.26*	*2.14*	*5.52*	*100.00*
USA								
1982	*13.63*	*5.69*	*31.39*	*16.45*	*24.36*	*5.86*	*2.60*	*100.00*
1985	*12.74*	*6.73*	*31.73*	*14.11*	*26.67*	*4.04*	*3.99*	*100.00*
1990	*9.01*	*6.55*	*44.26*	*6.83*	*23.53*	*4.40*	*5.43*	*100.00*

Source: Appendix Table 1

II.2.ii. *The Composition of Gross Commodity Output: Final Demand vs Intermediate Sales*

Estimates of total final demand as a proportion of gross output show wider differences across component transport industries as well as over the period 1982-1990. There are some differences between national and regional figures also. Thus, if we look over the figures for the state of Minnesota, we may see that in 1982 total final demand ranged from 12% to 75% of the overall demand for gross production across the different transportation industries; in 1985 this changed to 39% to 75% and in 1990 to 13% to 93%. Viewed at the individual industry level over time, observation shows total final demand falling in the case of railroads, local passenger transit and industries and rising in the other industries over the period 1982-85. Just the opposite happened over the period 1985-1990 with the only exception that total final demand for air and water transportation services continued rising.

At the national level, we may observe that the relative share of final demand in gross output has gone through broad changes across all transportation industries. Thus while for the year 1982, final demand ranged from 21% to 64% of the gross output; in 1985 it ranged from 18% to 72% and in 1990 from 13% to 56%. Inter-industry comparisons show that during the period 1982-1985, the relative share of final demand fell in the case of the railroads, local passenger, motor freight and motor freight industries. Air, transportation services, pipelines and water transportation had their final demand increased. During the period 1985-1990, this pattern changed almost totally as only services and pipelines had a fall in the final demand relative to intermediate demand. In all other cases final demand as a proportion of total output rose substantially. A summary of these tendencies is presented below:

Table 2: **Final Demand as Percent of Total Commodity Output Across the Different Transportation Industries**

Region/ Year	Transportation Industry						
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services
	40	41	42	44	45	46	47
MN							
1982	*58.09*	*74.63*	*41.75*	*38.14*	*62.55*	*20.67*	*11.74*
1985	*43.14*	*71.88*	*49.49*	*38.80*	*74.68*	*56.89*	*53.03*
1990	*61.50*	*93.58*	*38.99*	*89.10*	*89.13*	*13.28*	*33.61*
USA							
1982	*28.43*	*63.91*	*25.29*	*41.65*	*45.42*	*13.86*	*21.07*
1985	*20.30*	*53.93*	*18.22*	*47.11*	*71.75*	*40.64*	*68.52*
1990	*52.72*	*92.18*	*27.46*	*94.85*	*85.29*	*13.36*	*25.20*

Source: Appendix Table 1

II.2.iii. *The Composition of Final Demand*

Of the four components of final demand, household demand constitutes the major part. Across the different transportation industries, however, the composition is not the same and has changed over the period 1982-1990. Looking over the figures for Minnesota, we observe that over the period 1982-85, household demand as a percent of final demand rose only in the case of services and pipeline industries. Just the opposite happened over the period 1985-90 with the only exception that household demand as percent of final demand continued going down in the air transportation industry. At the national level, railroads, motor freight, water and local passenger industries experienced declining household demand during 1982-1985 and with the exception of local passenger, a rising demand during 1985-1990. The other component industries, identified by SIC-45, 46, 47 had exactly the opposite experience.

Table 3: Household Demand as a Percent of Total Final Demand by Different Transportation Industries

Region/ Year	Transportation Industry						
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services
	40	41	42	44	45	46	47
MN							
1982	*14.13*	*37.51*	*29.34*	*51.66*	*57.21*	*71.03*	*28.04*
1985	*7.12*	*25.65*	*6.63*	*20.93*	*54.79*	*85.71*	*75.00*
1990	*33.23*	*47.68*	*33.96*	*66.59*	*47.49*	*56.84*	*36.01*
USA							
1982	*51.07*	*65.23*	*58.22*	*22.11*	*72.27*	*71.54*	*57.79*
1985	*24.66*	*63.02*	*34.63*	*9.13*	*77.89*	*80.69*	*72.40*
1990	*58.97*	*60.61*	*61.83*	*29.01*	*72.76*	*56.99*	*51.25*

Source: Appendix Table 1

II.2.iv. *Exports and Other Components of Final Demand*

The contrasting tendencies of household demand can better be seen in the context of changes in the other constituent categories of final demand such as exports, capital formation, and state and federal government sales to final demand. Thus IMPLAN's estimates show only exports to account for a sizeable proportion of final demand in all the transportation industries excepting local and urban passenger transit and pipelines (except natural gas) industries. Further, exports have increased throughout the period 1982-1990 across all the transportation industries excepting water and railroad industries.

The pattern of change in the case of the rest of the final demand categories is not as easily discernable because of their erratic behavior. IMPLAN's estimates on the size and growth of exports are presented below:

Table 4: **Exports as Percent of Total Final Demand Across the Different Transportation Industries**

Region/ Year	Transportation Industry						
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services
	40	41	42	44	45	46	47
MN							
1982	*68.33*	*6.85*	*45.66*	*33.81*	*30.55*	*9.93*	*54.30*
1985	*89.04*	*0.00*	*82.07*	*55.02*	*40.10*	*7.11*	*22.49*
1990	*59.76*	*18.07*	*59.18*	*30.33*	*48.40*	*35.99*	*63.55*
USA							
1982	*30.84*	*0.00*	*12.27*	*64.30*	*12.35*	*14.66*	*40.54*
1985	*49.40*	*0.00*	*22.35*	*72.03*	*12.91*	*9.96*	*20.48*
1990	*30.07*	*0.0005*	*23.96*	*57.65*	*18.88*	*35.78*	*2.86*

Source: Appendix Table 1

II.3 Income Generation or Gross Outlay And Its Distribution

IMPLAN uses the term total industry output (TIO) to refer to gross outlay and distributes it into intermediate purchases, value-added, imports—both competitive as well as non-competitive—and total inventory reduction. The value-added component is further distinguished into:

i. Employee compensation

ii. Proprietor's income

iii. Indirect business taxes

iv. Other proprietor income

Algebraically, for a given industry 'j', we may write this as:

$$x_j = \sum_{j=1}^{m} x_{ij} + \sum_{f=1}^{n} v_{fj} + \sum_{i=1}^{s} c_{ij} + \sum_{t=1}^{T} nc_{ij} \qquad i, j=1...m,\ f=1...n$$

where x_j = total gross outlay of industry j;

x_{ij} = intermediate input purchase by industry j from i (i, j=1...m);

v_{fj} = value added by primary factor f in industry j (j=1...m, f=1...n);

c_{ij} = imports by industry j which are substitutes for the products of local industry i (i, j=1,...s, j, i=1...s);

nc_{tj} = imports by industry j that are non-competitive to those produced by the local industry t (t=1...T).

II.3.i. *Gross Outlay Level*

In terms of the level of gross outlay, only air, motor freight and water transportation were the big industries in 1982 both at the regional as well as national level. While all of these still dominate the transportation sector, water transportation has lost its position. Thus 1990 IMPLAN's estimates show air and freight to account for 67% of the whole transportation sector's gross outlay. Detailed figures, regarding the level of TI0 across the different transportation industries, both at the national and Minnesota level, are given below:

Table 5: Transportation Sector Industries Distinguished by Percentage Distribution of Gross Outlay (in 1990 million dollars)

Region/ Year	Transportation Industry							
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services	
	40	41	42	44	45	46	47	Aggregate
MN								
1982	*14.66*	*15.45*	*22.45*	*30.04*	*12.47*	*2.59*	*2.35*	*100.00*
1985	*11.21*	*15.13*	*31.59*	*20.49*	*15.97*	*1.91*	*3.70*	*100.00*
1990	*10.90*	*4.89*	*38.77*	*1.99*	*35.04*	*2.18*	*6.23*	*100.00*
USA								
1982	*9.57*	*15.31*	*33.13*	*24.17*	*10.03*	*4.84*	*2.94*	*100.00*
1985	*9.92*	*15.08*	*31.73*	*19.77*	*14.59*	*3.90*	*4.99*	*100.00*
1990	*8.99*	*6.64*	*45.24*	*6.86*	*22.39*	*4.47*	*7.40*	*100.00*

Source: Appendix Table 2

II.3.ii. *The Composition of Gross Outlay: Value-Added vs Intermediate Purchases*

Value added as proportion of gross outlay show sizeable differences when national vs regional comparisons are made. Thus we see that at the national level, with the exception of the water transportation industry where value-added has ranged from 16% to 32% of total industry output, in all the other transportation industries the share of value added has been quite high. Furthermore, this share has persisted over the period 1982-1990. There do exist differences across industries in this regard but these are not outside the range of ± 7% except in the case of passenger transit when the deviation has been large. Detailed figures on value-added as proportion of gross outlay are given as:

Table 6: Value Added as Percent of Gross Outlay Across the Different Transportation Industries

Region/ Year	Transportation Industry						
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services
	40	41	42	44	45	46	47
MN							
1982	*85.54*	*27.94*	*85.57*	*3.29*	*91.90*	*70.35*	*70.13*
1985	*81.93*	*18.75*	*90.61*	*6.79*	*96.44*	*50.05*	*79.12*
1990	*66.48*	*64.95*	*61.47*	*29.02*	*59.86*	*68.47*	*58.62*
USA							
1982	*82.28*	*22.55*	*61.76*	*16.00*	*79.79*	*75.56*	*72.83*
1985	*79.54*	*21.34*	*71.22*	*21.02*	*90.30*	*62.18*	*83.04*
1990	*67.26*	*67.42*	*61.31*	*32.26*	*56.21*	*68.47*	*64.15*

Source: Appendix Table 2

II.3.iii. *The Composition of Value-Added*

Among the components of value-added, employee compensation ranged from 52% to 101.29% across the different transportation industries irrespective of the year with the exception of pipeline where it stayed below 21%. Furthermore, we notice that in the case of motor freight and pipeline industries, employee compensation as percent of value-added has

been drifting toward the lower side of range. Figures on employee compensation as a major component of value-added are summarized below:

Table 7: Employee Compensation as Percent of Value-Added Across the Different Transportation Industries

Region/ Year	Transportation Industry						
	Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services
	40	41	42	44	45	46	47
MN							
1982	*82.43*	*73.33*	*70.17*	*70.77*	*77.76*	*14.99*	*71.03*
1985	*85.94*	*63.36*	*52.02*	*56.49*	*67.92*	*20.94*	*65.96*
1990	*85.53*	*77.31*	*56.02*	*101.29*	*85.15*	*10.59*	*83.15*
USA							
1982	*82.43*	*73.33*	*70.17*	*70.76*	*77.76*	*14.99*	*68.95*
1985	*88.16*	*66.80*	*67.83*	*70.62*	*58.89*	*18.89*	*53.96*
1990	*85.06*	*77.43*	*60.51*	*100.74*	*82.23*	*10.54*	*83.72*

Source: Appendix Table 2

III. Inter-industry Linkages

III.1. The Notion of Linkages

Inter-industry linkages refer to the sale and purchasing of output by the different industries for further production. Following Hirschman,[12] inter-industry linkages may be either of forward or backward type. Specifically, a forward linkage arises when an industry provides input to other industries and in so doing stimulates increases in the output levels of the absorbing industries. On the other hand, a backward linkage is said to exist when an industry by absorbing inputs from other industries help expand their production.

[12] *Hirschman, Albert O., "The Strategy of Economic Development," Yale University Press, New Haven, Connecticut, 1958.*

To quantify the notion of interindustry linkages[13] consider the system of equations:

$$x_i = \sum_{j=1}^{m} z_{ij}\, x_{jD} \qquad i=1,\ldots m$$

where x_i is total output, x_{jD} (j=1...m) is total final demand for the output of industry 'j' and z_{ij} (i and j=1...m) are the characteristic elements of the inverse Leontief matrix of coefficients, and define the "index of the power or dispersion" (U_j) and "the index of the sensitivity of dispersion" (U_i^w):

$$U_j = \frac{1}{m} \sum_{i=1}^{m} z_{ij} \Big/ \frac{1}{m^2} \sum_{j=1}^{m} \sum_{i=1}^{m} z_{ij} \qquad j=1\ldots m$$

and

$$U_i^w = \frac{1}{m}\, z_i^w \Big/ \frac{1}{m^2} \sum_{i=1}^{m} z_i^w \qquad i=1\ldots m$$

where $z_i^w = m \sum_{j=1}^{m} z_{ij}\, x_{jD} \Big/ \sum_{j=1}^{m} x_{jD}$

is used as weight to reflect each individual industry's importance in final demand. U_j ("*index of the power of dispersion*" of industry j) expresses the extent of expansion caused in the system of industries in general by an expansion in industry j, i.e, high values of U_j indicates that industry "j" draws heavily on the system of industries and hence captures the backward linkage effect. Specifically, if for a particular industry 'j', the above measure has a value in excess of unity, then a unit increase in the final demand for good j gives rise to a greater than average impact on the supplying sectors and conversely for U_j less than unity.[14]

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[13] *Norregaard Rasmussen, "Studies in Intersector Relations," North-Holland Publishing Company, Amsterdam, 1956, pp. 133-142.*

[14] *Parikh, A. and David Bailey, "The Techniques of Economic Analysis with Applications," Harvester Wheatsheaf, Hemel Hempstead, UK, 1990.*

On the other hand, the index U_i^w, which captures the forward linkage effect is called "*index of the sensitivity of dispersion*" for industry i. It expresses the extent to which the system of industries relies on industry i. Values of U_i greater than unity means that the industry i will have to increase its output more than other industries in order to meet the changing requirements of other industries precipitated by changes in final demand.

To the extent these linkages are concentrated in one or a small number of sectors or are more evenly spread across the economy, one needs to consider the Coefficient of Variation (CV) along with "*indices of power and sensitivity dispersion*":

$$CV_j = \left\{ \frac{1}{m-1} \sum_{i=1}^{m} \left(z_{ij} - \frac{1}{m} \sum_{i=1}^{m} z_{ij} \right)^2 \right\}^{1/2} \Big/ \frac{1}{m} \sum_{i=1}^{m} z_{ij} \qquad j = 1 \ldots m$$

$$CV_i = \left\{ \frac{1}{m-1} \sum_{j=1}^{m} \left(z_{ij} - \frac{1}{m} \sum_{j=1}^{m} z_{ij} \right)^2 \right\}^{1/2} \Big/ \frac{1}{m} \sum_{j=1}^{m} z_{ij} \qquad i = 1 \ldots m$$

Based on these indices one may arrive at the relative importance of a given industry given a system of industries. Specifically industries with high U's and low CV's would be classified as the most important.

III.2. IMPLAN Estimates on Inter-Industry Linkages

Utilizing these indices with IMPLAN data, both the forward and backward linkages associated with the transportation services industries were quantified for 1982, and 1990. The results may be seen from the following table:

Table 8: Transportation Industries Distinguished by Inter-industry Linkages

Region/Year		Transportation Industry						
		Railroads	Transit	Motor Freight	Water	Air	Pipeline	Services
		40	41	42	44	45	46	47
MN	1982							
	U_i^*	*0.46*	*0.14*	*0.65*	*0.08*	*0.80*	*0.05*	*0.06*
	CV_i	*6.05*	*7.06*	*5.24*	*7.19*	*4.93*	*7.01*	*6.77*
	U_j	*1.06*	*0.90*	*1.01*	*1.17*	*1.11*	*1.06*	*1.11*
	CV_j	*5.51*	*6.15*	*6.09*	*5.88*	*5.41*	*5.30*	*5.01*
	1990							
	U_i^*	*0.22*	*0.10*	*0.78*	*0.04*	*0.71*	*0.04*	*0.13*
	CV_i	*6.99*	*7.54*	*5.29*	*7.58*	*6.89*	*7.14*	*6.38*
	U_j	*1.00*	*0.95*	*1.04*	*1.16*	*1.01*	*0.82*	*1.12*
	CV_j	*5.95*	*6.19*	*6.39*	*5.08*	*5.82*	*7.13*	*5.35*
USA	1982							
	U_i^*	*0.29*	*0.11*	*0.69*	*0.33*	*0.56*	*0.10*	*0.08*
	CV_i	*7.31*	*3.67*	*4.88*	*6.79*	*6.88*	*6.48*	*3.83*
	U_j	*0.97*	*0.78*	*0.87*	*1.25*	*1.08*	*0.93*	*0.89*
	CV_j	*4.28*	*5.01*	*5.13*	*4.85*	*3.40*	*4.28*	*4.42*
	1990							
	U_i^*	*0.15*	*0.08*	*0.78*	*0.12*	*0.38*	*0.08*	*0.12*
	CV_i	*6.68*	*7.53*	*4.35*	*7.55*	*6.88*	*6.64*	*6.12*
	U_j	*0.91*	*0.87*	*0.94*	*1.21*	*0.98*	*0.78*	*0.95*
	CV_j	*5.07*	*5.19*	*5.67*	*3.82*	*4.66*	*5.92*	*4.93*

Source: IMPLAN's Report No: 601 – Leontief Inverse Multiplier Matrix and Report No: 403 – Aggregated Demand.

Looking at the linkages estimates for the nation, we may see that in 1982, motor freight and air transportation were the only industries that had the strongest forward linkages (i.e., high U_i^*) along with a more even distribution of effect (i.e., low CV_i's) on the purchasing industries. In contrast, local passenger and pipeline industries had the weakest and more dispersed forward linkages of the seven transportation industries. But things seem to have changed: 1990 IMPLAN estimates show that motor freight and transportation

services linkages have gotten stronger. For all other industries they have gotten weaker. Particularly, railroads and water transportation industry linkages have gotten substantially weaker as the associated U_i^w and CV^i for these industries suggest.

With regard to the identification of industries with strongest backward linkages, we may see that while in 1982 air and water transportation industries had the strongest and evenly distributed backward linkages (i.e., high U_j's and low CV_j's); in 1990 only water transportation had that status. In general, if we take a glance at the backward and forward linkages, we may notice that for the whole transportation sector, the former are stronger than the latter.

Looking at the regional level—Minnesota—we may see that while in 1982 motor freight, air transportation and railroads had the strongest and evenly distributed forward linkages, in 1990 only motor freight and air transportation retain that position with air having lost some of its importance in the final demand sector. With regard to backward linkages only the local passenger industry had the weakest such linkages both in 1982 as well as in 1990.

IV. Growth Performance

Performance of an industry or industries can be looked at from the perspective of growth in final or intermediate demand, total output, employment or value-added by any or all primary factors.[15] We choose to look at the employment growth. Results in this respect are presented in the ensuing two sub-sections.

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[15] *See Osmo Forssell, Changes in the Structure of the Finnish Economy, 1970-1980 in (ed) Smyshlyaev, Input-Output Modelling, Springer-Verlag, Berlin, 1985.*

IV.1. Economy-wide Comparisons

The overall Minnesota employment growth rate over the period 1982-85 was 16.76% (or 4.19% per annum) as against the overall U.S. employment growth rate of 16.56% (or 4.14% per annum). The edge of Minnesota over the U.S. continues to widen as we enter the period 1985-1990. During this period, we see that while U.S. employment grew by 19.63% (or 3.27% per annum) Minnesota overall employment grew by 28.11% (or 4.69% peer annum). Considering the whole period 1982-1990, the U.S. lagged Minnesota in terms of employment growth by 19.85% (or by 1.21% per annum).

IV.2. Employment Level in the Transportation Industries

As judged by the level of employment, we observe that motor freight, air and railroad transportation dominate the scene both at the national and regional level. On the other hand, the industry with the lowest level of employment is pipeline (SIC-46).

Viewed over time, industries with falling employment levels are railroads and pipelines. All the others, except water transportation, have been growing. Details in this respect may be seen from the following table:

Table 9: **Transportation Industries Distinguished by Level of Employment (in "000" thousands)**

Transportation Industry	USA			MN		
	1982	1985	1990	1982	1985	1990
Railroads	*400*	*300*	*300*	*11.656*	*8.732*	*7.291*
Transit	*200*	*300*	*400*	*6.429*	*7.816*	*10.530*
Motor Freight	*1000*	*2000*	*2000*	*22.169*	*34.880*	*36.045*
Water	*200*	*200*	*200*	*0.790*	*1.315*	*1.217*
Air	*400*	*500*	*700*	*9.782*	*14.541*	*21.356*
Pipeline	*21.615*	*19*	*18.371*	*0.182*	*0.177*	*0.214*
Services	*200*	*300*	*400*	*2.919*	*5.995*	*8.665*
Economy-wide Employment Level	*91800*	*107000*	*128000*	*1790*	*2090*	*2690*

Source: IMPLAN's Report No. 404 – Aggregated Final Payments.

IV.3. Sources of Growth

To look into employment growth in the transportation sector and to decompose the sources of this growth we used shift-share technique.[16] Following Blair,[17] the formula for calculating the shift-and-share components for a single industry can be expressed as:

$$\Delta e_i = e_i [(US^*/US) - 1] + e_i [(US_i^*/US_i) - (US^*/US)] + e_i [(e_i^*/e_i) - (US_i^*/US_i)]$$

where Δe_i = change in local employment in industry i.

e_i = local employment in industry i at the beginning of the period.

e_i^* = local employment in the industry i at the end of the period.

US^* = total U.S. employment at the end of the period.

US = total U.S. employment at the beginning of the study period.

The first term i.e., $e_i [(US^*/US) - 1]$, known as the national share effect indicates growth that would occur if local industry i grew at the national average rate. The remaining two components i.e., $e_i [(US_i^*/US_i) - (US^*/US)]$ and $e_i [(e_i^*/e_i) - (US_i^*/US_i)]$, respectively known as the industry mix[18] and competitive effect, constitute the shift effect. Of these the former indicates extra (reduced) growth because a particular industry grew more (less) rapidly than the overall national average. The later indicates that local industry grew more (less) rapidly than the national rate for industry i.

It is important to appreciate that mix and competitive effects are quite distinct phenomenon and as their investigation requires us to look at quite different forces. Specifically, to understand mix effect one needs to focus on forces affecting the composition

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[16] *For the alternative versions of shift-share technique and a detailed critical review, see Selting, Anne C., and Scott Loveridge, "A Summary of the Literature on Shift-Share Analysis," Staff Paper P92-13, Dept. of Agric. and Applied Economics, University of Minnesota, St. Paul, 1992.*

[17] *Blair, John, Urban and Regional Economics, Richard D. Irwin, Inc., 1991, p. 187.*

[18] *Also respectively known as the proportionality and differential effects in the regional science literature.*

of employment on the national scene. On the other hand, to understand the competitive effect, one needs to consider the locational advantages/disadvantages a local economy may have vis-a-vis other regions.[19] Results obtained via shift and share analysis are reported below:

Table 10: Employment Growth Performance: A Shift-Share Analysis

SIC Code	1982-1985				1985-1990				1982-1990			
	Actual Net Change	Nat'l Share Effect	Shift Effect 1*	Shift Effect 2*	Actual Net Change	Nat'l Share Effect	Shift Effect 1*	Shift Effect 2*	Actual Net Change	Nat'l Share Effect	Shift Effect 1*	Shift Effect 2*
40	-2920.3	1930	-4840	10.3	-1440	3440	-3440	-1440	-4360	4600	-7510	-1450
41	1380	1060	2150	-1830	2712	3080	-477	109	4100	2540	3890	-2330
42	12710	3670	18500	-9460	1160	13800	-13800	1160	13850	8740	13400	-8290
44	525	131	-131	525	-97.7	518	-518	-97.7	427	312	-312	427
45	3298	162	826	2310	5912.3	5730	82.4	99.9	11610	3860	3480	4270
46	-5.6	30.1	-52.2	16.5	38	69.6	-75	43.4	32	71.8	-99.1	59.3
47	3079	483	976	1620	2665	2360	-366	671	5750	1150	1770	2830

1* = Industry Mix
2* = Competitive

Source: IMPLAN's Report No. 404 – Aggregated Final Payments.

As judged by actual employment change, IMPLAN estimates a higher growth performance for Minnesota transport sectors than the national average for the period 1982-1990. Thus if Minnesota were to grow at the national rate, it would have lost employment as the national share effect would suggest. Regarding the source of this growth, we find that it was mainly due to the mix effect i.e. Minnesota had disproportionately large employment in this sector that was among the fastest growing sectors nation-wide. This is brought out if we look at the individual transport industries, e.g. air, motor freight, local passenger and transportation services.

[19] *Richardson, H.W., "Regional Economics," Praeger Publishers, New York, 1969, p. 345.*

However, while Minnesota gained jobs because of disproportionately large employment in the nation's fastest growing industries, vis-a-vis other regions, it lost employment in some transportation industries as suggested by the competitive effect for railroads, local passenger and motor freight. Based on these observations, if we limit our focus to railroads and motor freight, we find that while railroads lost employment because (i) this sector was one of the nation's slow growing industries and (ii) the industry was doing worse than its counterparts in other regions, the motor freight sector, while growing faster than the nation's average did not grow as fast as its counterparts in other regions.

Figures on the sub-periods can be interpreted the same way although it is very clear, that while IMPLAN estimates for the period 1982-85 exhibit the same pattern as that for the period 1982-1990, the same cannot be said of the period 1985-1990. In fact just the opposite prevailed i.e., overall employment in Minnesota transportation sector fell vis-a-vis the nation due not to the competitive but to the mix effect. Furthermore, railroads have lost employment vis-a-vis the nation both because of the mix and competitive effect in each sub-period.

V. Summary of Findings

V.1. Qualifying Remarks on the Database

Before presenting a summary of the main findings we would like to point out certain factors that may lower the quality of IMPLAN estimates.

i) The IMPLAN databases used in this study are of partial-survey type—generated through the RAS technique and calibrated to the U.S. national income and products accounts

for the years 1982, 1985 and 1990. Input-output literature suggests that RAS estimates are usually upward biased.[20]

ii) The margins associated with the transportation service industry are derived from the U.S. 1977 input-output model of the Bureau of Economic Analysis, U.S. Department of Commerce and price-updated to the respective database years. To the extent there has been productivity change, either in terms of quality or otherwise, IMPLAN estimates of gross output are going to be biased.

iii) For the purposes of this study, all figures have been converted to 1990 million dollars, using IMPLAN deflators as derived from the Bureau of Labor Statistics (BLS) unpublished growth model. We remind our readers that these deflators operate on the output side only. Since we have applied them to all the categories of final demand and value-added, the readers are advised to take into account any discrepancies that might arise due to this difference in treatment.

iv) Employment figures in the 1982 and 1985 databases were underestimated and hence some of the employment growth that we observe in the 1990 databases is due to better accounting rather than growth itself.

v) Finally, as the readers may notice, IMPLAN figures on Minnesota and U.S.A. transportation services industries reveal the same pattern. This could be ascribed to the proportionality implicit in input-output modelling, the partial survey nature of the data as generated through the RAS technique, or even the true state of affairs.

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[20] *Hewings and Jensen point out that, apart from certain logical flaws, the continued discussion on the theoretical and empirical applications of these non-survey techniques continues to point out to a consensus conclusion that they have acknowledged bias and that be supported as single-step technique for producing regional tables. Hewing, G.J.D. and Jensen R.C., Regional Interregional and Multi-regional Input-Output Analysis in (ed) Peter Nijkamp Handbook of Regional and Urban Economics, North-Holland, Amsterdam, 1986. Also see Parikh, A., who tested data generated through RAS techniques for nine European countries and found errors. Parikh, Ashok, "Forecasts of Input-Output Matrices Using the RAS Method," Review of Economics and Statistics, 61, 477-81, 1979.*

Having qualified certain aspects of the databases used in the study, the main findings[21] of this paper, based on the statistics reported above and the appendices at the end of the paper, are presented below in response to the objectives set out in the introduction.

V.2 General Characteristics of the Transport Sector

V.2.i. *Size and Growth of Gross Commodity Output*

In terms of the level of total commodity output, motor freight and air dominate the transportation sector. At the national level, motor freight and air industries respectively accounted for 31.39% and 24.36% of the overall transportation sectors gross commodity output in 1982. In the case of motor freight the share rose even further to 44.26% in 1990 though for the air industry it stayed at the same level.

Of the remaining industries, railroads and water transportation, which respectively accounted for 13.63% and 16.45% of the sectors output in 1982, have been experiencing falling commodity output. Thus in 1990 their share came down to 9.01% and 6.83% respectively. Local passenger and urban transit and pipelines (except natural gas) continue to have the same 5% share in 1990 as they had in 1982. Lastly, services with 2.60% share in 1982, has experienced the fastest growth rate of all: in 1990 it accounted for 5.43% of the sectors overall output.

V.2.ii *The Composition of Gross Commodity Output: Final vs Intermediate Sales*

In input-output framework, gross commodity output is divided into two major categories viz; intermediate and final demand. Intermediate demand represents the sale of

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[21] *This summary concerns the period 1982-1990 only. No attempt is made to report findings on the sub-periods 1982-85 and 1985-1990. Readers interested in such information are referred to the main body of the paper and statistics reported therein.*

output by the different producing industries in the system for further production. Final demand, on the other hand, is the share of output destined for final consumption. IMPLAN's estimates on the relative position of these broad components of gross commodity output TC0 are summarized below:

Of the seven industries that constitute the transportation sector, over one-third of the intermediate demand for the sector's output was met by the motor freight industry in 1982. Over time, the amount of sales by this industry have risen further. Thus, in 1990, two-thirds of the sector's intermediate demand was met by this single industry. The rising demand for motor freight services entailed reduced shares for the other constituent industries' output. These specifically included air, railroads and water transportation industries.

Besides motor freight the other industry that experienced rising intermediate demand was the services transportation industry. Pipelines (except natural gas) at best maintained its share as it stood in 1982.

National versus regional comparisons bring out certain points relating to the relative growth of final demand for the railroads and air transportation services. Thus, we find that while both at the national as well as regional level i) railroads experienced declining growth rate in the final demand for its services the rate was higher (a higher negative number) at the regional level, ii) air transportation experienced a rising growth rate in the final demand for its services, the rate was comparatively higher (a higher positive number) at the regional level.

V.2.iii. *Size and Growth of Gross Outlay*

Of the overall sector's outlay, motor freight and water transportation accounted for 57% in 1982. The other two heavy purchasers were local and urban passenger transit and air transportation industry. These two industries respectively accounted for 15.31% and 10.03% of the transportation sectors aggregate outlay in 1982. These seem to have been large changes over the past decades as 1990 IMPLAN's estimate show. Thus we observe motor freight and air transportation industries to account for almost 70% of the sectors outlay.

Among the industries with declining gross outlay were water and local and urban passenger transit while railroads and pipelines (except gas) maintained their 1982 levels.

V.2.iv. *The Composition of Gross Outlay: Value-Added vs Intermediate Purchases*

Gross outlay is broadly divided into value-added and intermediate purchases. IMPLAN's estimates regarding the distribution of gross outlay into its components show that with the exception of water and local and urban passenger transit industries, all the other transportation industries had value-added as high as 60-82% of the gross outlay in the year 1982. This pattern of the relative distribution of value-added vs intermediate purchases changed over the period 1982-1990. Thus, 1990 IMPLAN estimates show railroads, air, pipelines (except natural gas) and services to have experienced declining shares of value-added relative to intermediate purchases while local and urban passenger transit and water transportation industries, on the other hand, had just the opposite experience. The only transportation industry where the relative position of value-added vis-a-vis the intermediate purchases remained the same was motor freight.

V.3. Inter-industry Linkages

Of the various transportation industries, this study finds motor freight and air transportation to have had stronger forward linkages in 1982, as well as in 1990. This is suggested by the comparatively higher indices of sensitivity and power of dispersion and low coefficients of variation (CV's) for these industries. This means that when final demand increases by one unit, these industries will have to absorb this shock in terms of expanding their output. We see that these forward linkages have gotten stronger for the motor freight relative to air transportation both at the regional as well as national level.

Of the remaining transportation industries, only railroads and local passenger have comparatively high indices of sensitivity and lower indices of power of dispersion which seem to have weakened as shown by the results for 1990 relative to 1982. On the other hand, transportation services seem to have gotten stronger in terms of forward linkages—regionally as well as at the national level.

With regard to backward linkages, which measures the reliance of a given industry on the rest of the system of industries, we find water and air transportation have had stronger backward linkages in 1982. The 1990 data, however, shows air transportation to have lost some of its linkage effect. Further, motor freight and transportation services seem to have gained in this respect. Among the other industries where such linkages have weakened are railroads and pipelines—both at the regional and national level.

V.4. Employment

Air, motor freight and railroads were the few transportation industries that accounted for a dominant proportion of the total employment in the transportation sector in 1982. Of these, railroads lost its position thus joining pipelines and water transportation as the least

significant employment-providing industries. Air and transport services were the only industries with rapid employment growth over the period 1982-1990.

Regarding the reasons for these employment changes in the transport sector, results of shift-share analysis show that railroads lost employment both because of the industry mix as well as competitive effect—meaning that not only did it lag behind in terms of the average national growth rate but it also did worse vis-a-vis its counterparts in other regions.

The other industries that lost employment because of the negative mix effect were local passenger and motor freight. Industries that lost employment because of negative competitive effect were pipelines and water transportation. Industries for which both these effects were positive were air and transportation services.

APPENDIX TABLES

Appendix Table 1:Gross Commodity Output and its Composition

(1990 million dollars)

		Railroads	Transit	Freight	Water	Air	Pipelines	Services	Aggregate
		40	41	42	44	45	46	47	
Total Commodity Output	Year								
MN									
	1982	721.87	206.83	986.63	151.75	1144.61	97.67	70.14	3379.5
	1985	683.9	265.76	1737.2	220.39	1436.28	74.62	143.13	4561.28
	1990	654.03	382.08	2320.96	121.48	2148.88	130.11	336.59	6094.13
USA									
	1982	25269.43	10567.49	58225.1	30505.4	45180.47	10862.83	4828.72	185439.44
	1985	26343.05	13917.42	65634.51	29175.7	55166.19	8362.96	8246.23	206846.06
	1990	25742.02	18712.53	126516.6	19508.48	67261.34	12577.01	15512.99	285830.97
Intermediate Demand									
MN									
	1982	302.54	52.46	574.74	93.87	428.68	77.48	61.91	1591.68
	1985	388.83	74.72	877.49	134.87	363.68	32.17	67.24	1939
	1990	251.82	24.54	1416.09	13.24	233.66	112.84	223.47	2275.66
USA									
	1982	18085.86	3813.65	43526.32	17798.87	24661.29	9357.66	3811.17	121054.82
	1985	20996.56	6411.63	53675.52	15431.52	15582.56	4964.65	3234.14	120296.58
	1990	12169.63	1463.19	91779.13	1004.06	9093.79	10897.2	10698.29	137905.29
Final Demand									
MN									
	1982	419.33	154.36	411.89	57.88	715.93	20.19	8.24	1787.82
	1985	295.07	191.03	859.71	85.52	1072.59	42.45	75.89	2622.26
	1990	402.21	357.54	904.87	108.24	1915.22	17.28	113.12	3818.48
USA									
	1982	7183.58	6753.85	14698.78	12706.53	20519.19	1505.18	1017.55	64384.66
	1985	5346.49	7505.78	11958.99	13744.17	39583.63	3398.3	5012.09	86549.45
	1990	13572.39	17249.34	34737.46	18504.42	57367.55	1679.81	4814.7	147925.67
Household									
MN									
	1982	70.51	82.72	145.61	33.98	538.89	14.2	2.99	888.9
	1985	23.46	60.05	68.2	19.36	726.32	33.92	71.47	1002.78
	1990	133.66	170.49	307.33	72.09	909.61	9.82	40.73	1643.73
USA									
	1982	3668.96	4405.58	8558.03	2808.89	14829.21	1076.84	588.01	35935.52
	1985	1318.47	4730.36	4140.95	1254.16	30834.18	2742.39	3628.93	48649.44
	1990	8003.93	10454.9	21476.82	5367.65	41740.24	957.42	2212.45	90213.41
Federal Govt									
MN									
	1982	1.33	0.21	5.55	0.39	14.49	0.15	0	22.12
	1985	3.49	0.41	12.37	16.77	19.93	0	1.2	54.17
	1990	0	0	0.187	0.06	9.13	0	0	9.377
USA									
	1982	573.06	73.89	2235.79	1413.05	1662.9	81.45	0	6040.14
	1985	954.38	57.12	242.17	2314.81	1948.66	21.13	329.73	5868
	1990	161.53	73.49	887.31	2127.55	2211.7	12.76	57.58	5531.92
State & Local Govt									
MN									
	1982	11.65	81.14	49.96	4.09	0	3.71	0.12	150.67
	1985	4.99	141.39	22.79	2.92	33.31	2.94	0.45	208.79
	1990	10.62	122.42	39.51	2.49	51.95	1.24	0.5	228.73
USA									
	1982	191.66	2274.37	1358.44	176.26	1231.15	126.16	16.98	5475.02
	1985	315.69	2718.3	1574.74	212.33	1659.02	217.01	26.85	6723.94
	1990	570.73	6720.94	2470.16	167.17	2141.48	108.55	24.04	12203.07
Capital Formation									
MN									
	1982	6.03	0	8.94	1.27	4.09	0	0	20.33
	1985	2.74	0	61.68	0.38	0.89	0.53	0	66.22
	1990	17.55	0	22.35	0.77	17.48	0	0	58.15
USA									
	1982	434.43	0	743.11	138.24	261.46	0	0	1577.24
	1985	116.61	0	3328.88	63.38	30.95	79.35	0	3619.17
	1990	755.26	0	1578.67	173.36	381.59	0	0	2888.88
Exports									
MN									
	1982	341.09	15.11	226.57	22.24	287.79	1.98	5.81	900.59
	1985	262.72	0	705.58	47.05	430.14	3.02	17.07	1465.58
	1990	240.38	64.63	535.49	32.83	927.05	6.22	71.88	1878.48
USA									
	1982	2215.47	0	1803.39	8170.09	2534.47	220.73	412.56	15356.71
	1985	3641.32	0	2672.25	9099.49	5110.81	338.42	1026.58	21688.87
	1990	4080.93	0.0098	8324.51	10668.69	10828.5	681.07	2520.36	37024.0698

Source:IMPLAN Report No.106:Regional Consumption Demand,Investment and Trade

Appendix 2:Gross Outlay and Its Composition

(in 1990 million Dollars)

		Railroads 40	Transit 41	Freight 42	water 44	Air 45	Pipelines 46	Services 47	Aggregate
Total Industry Outlay	Year								
MN									
	1982	450.5	474.69	689.97	923.09	383.2	79.57	72.28	3073.3
	1985	491.61	663.68	1385.94	899	700.6	83.98	162.45	4387.26
	1990	649.7	291.18	2310.59	118.97	2888.51	129.93	371.4	5960.28
USA									
	1982	16294.5	26853.64	56393.85	41132.81	17082.41	8239.2	5012.36	170207.97
	1985	19398.21	29487.66	62834.71	38647.94	28537.95	7630.29	9758.38	195495.14
	1990	25297.7	13851.54	127171	19275.8	62968.98	12558.82	20807.16	281131
Intermediate Demand									
MN									
	1982	65.16	342.08	99.54	892.69	31.03	23.59	21.59	1475.69
	1985	88.83	539.25	130.13	837.89	24.92	41.95	33.92	1696.89
	1990	217.76	102.07	890.34	84.45	838.26	48.97	153.7	2327.55
USA									
	1982	2887.38	20177.63	21566.7	34548.62	3452.94	2813.44	1362.04	86908.75
	1985	3968.75	23195.37	17852.13	36524.14	2767.34	2886.08	1654.69	82846.5
	1990	8283.22	4252.8	49286.5	13856.75	27573.43	3960.09	7458.95	113791.7
Value Added									
MN									
	1982	385.18	131.81	592.97	30.23	350.62	55.97	397.9	1944.68
	1985	403.15	123.84	1251.38	61.31	676.38	42.01	128.53	2686.6
	1990	431.94	189.11	1420.25	34.52	1250.25	88.96	217.7	3632.73
USA									
	1982	13407.12	5876.01	34826.35	6584.19	13629.47	6225.76	3650.32	84199.22
	1985	15429.46	6292.29	44182.58	8123.8	25770.61	4744.21	8103.69	112646.64
	1990	17014.48	8798.74	77964.5	6219.05	35395.55	8598.73	13348.21	167339.26
Employee Compensation									
MN									
	1982	317.52	96.65	416.08	21.39	272.65	8.39	282.63	1415.31
	1985	346.46	78.47	651.01	34.64	459.39	8.79	84.78	1663.54
	1990	373.75	146.2	795.58	34.96	1064.61	9.42	181.02	2605.54
USA									
	1982	11047.61	4282.76	24542.31	4633.37	10551.98	933.38	2519.41	58510.82
	1985	13614.89	4183.26	29864.57	5755.6	15192.19	895.74	15680.66	85186.91
	1990	14472.13	6812.78	47176.02	6265.51	29106.59	905.99	9500.22	114239.24
Indirect Business Taxes									
MN									
	1982	819.21	504.94	1454.04	286.99	1414.53	215.44	452.48	5147.63
	1985	229.43	168.24	1265.57	654.27	4246.05	357.4	4463.36	11324.32
	1990	14472.13	6812.78	47176.02	6265.51	29106.59	905.99	9500.22	114239.24
USA									
	1982	23.55	11.39	24.65	1.33	36.55	1.94	38.51	137.92
	1985	14.94	1.89	67.73	4.37	50.84	2.3	2.85	144.92
	1990	22.01	4.65	58.51	2.36	94.31	5.34	4.09	191.27
Personal Income									
MN									
	1982	0	4.2	40.67	-0.97	0.13	0	0.13	44.16
	1985	0	13.84	367.91	12.02	0.19	0	10.28	404.24
	1990	0.04	15.69	264.17	-1.15	35.79	0	19.11	333.65
USA									
	1982	0	186.09	2398.93	-209.8	5.04	0	458.22	2838.48
	1985	0	472.15	7101.83	374.52	29.65	0	29.28	8006.63
	1990	23.9	689.87	10043.42	-89.71	926.95	0	1682.54	13276.97
Other Personal Income									
MN									
	1982	44.12	19.57	111.57	8.48	41.29	45.64	76.63	347.3
	1985	41.76	29.63	164.73	10.28	165.95	30.91	30.61	473.87
	1990	36.14	22.56	301.99	-1.66	55.55	74.19	13.48	502.25
USA									
	1982	1534.93	866.96	6580.81	1836.75	1597.95	5076.32	223.86	17717.58
	1985	1599.56	1498.53	5795.47	1345.99	6329.46	3488.36	8884.04	28961.41
	1990	1399.48	1651.39	17906.97	-298.26	1518.79	7137.12	-16.62	29698.87

Source:IMPLAN Report No.107:Regional Final Payments

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