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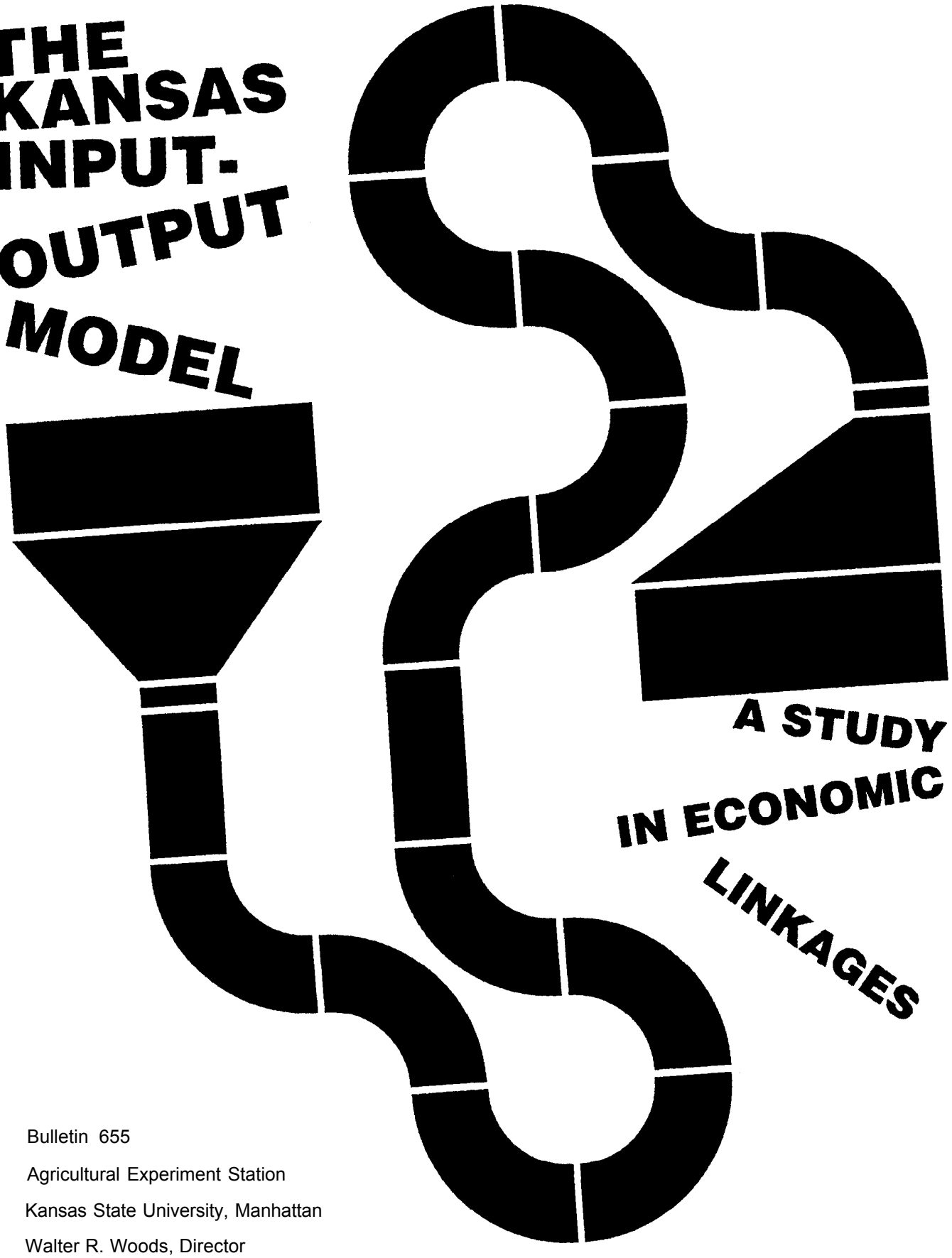
THE KANSAS INPUT-OUTPUT MODEL



A STUDY IN ECONOMIC LINKAGES

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Contents

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THE KANSAS INPUT-OUTPUT MODEL: A STUDY IN ECONOMIC LINKAGES*

M. Jarvin Emerson**

Introduction

What is the impact of a drought on the Kansas economy? If Kansas wheat and aircraft exports rise as a result of a depreciated dollar, what is the impact on other state industries? What is the impact on the Kansas economy of a decline in oil and gas production? How does the existing structure of the Kansas economy encourage or discourage certain types of economic development? How will policies to control water quality and quantity affect specific sectors of the Kansas economy?

A framework to answer such questions is presented in this report. This framework is a survey-based, input-output model for the state of Kansas with a base year of 1985. This is the latest in a series of models begun more than 20 years ago. State survey-data, input-output models have been constructed previously for 1965, 1969, and 1973. Models using secondary data have been estimated for several other years. In addition, substate models based on survey data have been developed for areas such as the Wichita and Topeka metropolitan areas and the High Plains-Ogallala Aquifer region of the state.

Each of the earlier models was developed to meet some identified state or regional need. The use of the models, however, extended well beyond the original intent, as is explained below.

Construction of the most recent model was funded by the Kansas Agricultural Experiment Station to ascertain the current linkages of agriculture with the rest of the state economy. However, the new model, like its predecessors, is industry-neutral with regard to emphasis. All but two sectors in the 1985 model are the same as in the earlier models. Thus, the utility of the model to the state of Kansas should again extend beyond its original purpose.

Model Structure

An input-output model is a quantitative framework of analysis for examining the complicated interdependence within the production system of an economy. There are four components to the standard model: an interindustry transactions matrix; a direct requirements matrix; a direct and indirect requirements matrix; and a direct, indirect, and induced requirements matrix. Each will be explained with the aid of a simple illustrative example.

The transactions matrix describes the flows of goods and services between all individual sectors of the economy in a given year. The columns of the transactions matrix show the composition of inputs required by a particular industry to produce its output. The rows of the transactions matrix display the distribution of a particular industry's output throughout the economy. In other words, columns show purchases by a particular industry from all other industries, and rows show sales by a particular industry to all other industries. For example, in the highly simplified example of an input-output transactions matrix appearing in Table 1, the data in the farming sector column show that, in order to produce its $30 million output, that sector purchased $4 million from farm enterprises, $7 million from manufacturing firms, and $6 million from trade establishments, and made $13 million of payments to the final payments sectors. The data in the farming sector row indicate that farming sold $4 million to farm enterprises, $8 million to manufacturing, $2 million to trade, and $16 million to final demand.

Table 1. Illustrative Input-Output Transactions Matrix

	Farming	Mfg.	Trade	Final Demand	Total Output
Farming	4	8	2	16	30
Manufacturing	7	15	6	22	50
Trade	6	5	4	10	25
Final Payments	13	22	13	0	48
Total Inputs	30	50	25	48	153

The direct requirements matrix indicates the requirements from each industry for a particular industry to produce an average $1 of output. These purchase coefficients are obtained by dividing purchase data in each industry column of the transactions matrix by the corresponding output value for that industry. The resulting purchase coefficients, or input ratios, may be thought of as production recipes for a particular product. From the data in the simplistic transactions matrix in Table 1, a direct requirements matrix can be calculated (Table 2). As an example, the first column (farming) shows that to produce an average $1 of output, the farming sector buys $.13 from farming enterprises,

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$.23 from manufacturing firms, and $.20 from trade firms, and makes $.44 of payments to the final payments sectors (households, gross savings, government, and imports). Of course, the sum of these input ratios is one.

The direct and indirect requirements matrix is one of two matrices that measures the interaction among industries. The other, the direct, indirect, and induced requirements matrix, is similar but includes the effects of household income and spending in addition to the interindustry interaction. The data in the columns of Table 3 for each industry indicate the direct and indirect requirements of all industries necessary for that industry to deliver $1 of output to final demand. The indirect requirements are those output increases necessary to supply inputs to industries supplying the direct inputs plus those output increases necessary to enable the expansion of those industries supplying inputs to the industries supplying inputs to the industries providing the direct inputs, etc. Therefore, the impact on the total output of the economy is significantly larger than just the impact of the output increase of the initial industry. As an example, for the farming sector to increase its output by $1, it must increase its output by $1.2844 (including the initial $1 increase), the manufacturing sector must increase its output $.5493, and the trade sector must increase its output $.3712. The total output increase of agriculture in this simplistic economy is the sum of these three values or 2.2049 times larger than the initial output expansion in agriculture. This is the concept of an output multiplier.

This matrix, along with the direct, indirect, and induced requirements matrix, permit the calculation of a variety of multipliers. A multiplier is a summary measure of the magnitude of the leverage that change in one industry has on other industries.

The basics of an input-output model can be represented as a system of linear equations and expressed in matrix form.

Let X_i = total output of industry i

X_{ij} = total amount of the product of industry i used by industry j

Y_i = total amount of X_i left over for final demand (consumption apart from that of other producing industries),

Then $X_i = Y_i + E_j X_{ij}$.

Let $a_{ij} = X_{ij}/X_j$,

Then $X_i - E_j a_{ij} X_j = Y_i$

Let A = matrix of a_{ij},

X = vector of industry outputs, Y = vector of final demands, and I = identity matrix,

Then $X = (I - A)^{-1} Y$.

Table 2. Illustrative Direct Requirements Matrix

	Farming	Mfg.	Trade
Farming	.13	.16	.08
Manufacturing	.23	.30	.24
Trade	.20	.10	.16
Final Payments	.44	.44	.52
Total	1.00	1.00	1.00

Table 3. Direct and Indirect Requirements Matrix

	Farming	Mfg.	Trade
Farming	1.2844	.3242	.2149
Manufacturing	.5493	1.6360	.5174
Trade	.3712	.2710	1.3031

Previous Kansas Input-Output Modeling

The origin of the first Kansas input-output model had some similarities to the current effort to develop economic modeling for the state. In the early 1960s, the sagging performance of the Kansas economy prompted a variety of state government actions, one of which was the formation of a Kansas Office of Economic Analysis. One of the charges to that office was to develop an economic modeling program. A committee comprised of state agency heads, legislators, business persons, labor leaders, and university faculty convened several times to consider the appropriate approach. Finally, the decision was made to construct a survey-based, input-output model.

Funded by an appropriation from the Legislature plus some matching funds from the U.S. Department of Housing and Urban Development, the model was begun in June of 1966, was completed in 1968, and was published in 1969. The model divided the state economy into approximately 75 industries or sectors. There were 69 processing sectors, 7 final demand sectors, and 5 final payments sectors. Similar models were developed for 1969 and 1973, as well as partial updates for other years. Models also were developed for several regions of the state.

The models and their extensions have been used for a variety of purposes, including (1) economic impact analysis; (2) identification of development potentials; (3) market analysis; (4) tax analysis; (5) resource development/depletion analysis; (6) dynamic simulation; (7) revenue forecasting; (8) import/export analysis; (9) occupational projections; (10) energy utilization; and (11) development projections.

Model Construction

The 1985 Kansas input-output model was developed using survey data (interviews) as the basis for estimating the interindustry transactions for most of the sectors. The interviewing was primarily accomplished during 1986-87. About a dozen persons were involved in the interviewing, including professors, graduate students, and undergraduate students. A major consideration in selecting interviewers was sufficient accounting skill. Training sessions were conducted to familiarize the interviewers with the nature of the data needed to construct an input-output transactions matrix. The completion of a "successful" interview usually involved more than one visit to a firm, phone calls, and correspondence.

Data from various federal and state government agencies also were used, primarily to obtain information such as total output values, personal income, and government payments and receipts. Because much of this information has a 6 to 20 month lag in its release, the transactions matrix could not be completed until after these data became available.

The sectoring scheme for the 1985 model was the same as that of the earlier version with two exceptions: the education sector was not separated from the government sectors, and inventory change was included in the investment column. The 1985 transactions matrix has 68 industry sectors, 6 final payments sectors, and 7 final demand sectors.

Unlike the previous input-output models, which were constructed with the aid of a mainframe computer, this model was constructed almost entirely with a microcomputer. The mainframe was used only to read and sort data tapes. The model is available in spreadsheet form on 5 1/4 inch disks.

The sector definitions appear in Table 4. The majority of the nonagricultural sector definitions are based on standard industrial classification (SIC) definitions for establishments. The farm sectors are defined on a commodity basis, rather than an establishment basis.

Table 4. Industry and Sector Definitions

Farming

Farming sectors are defined on a commodity basis rather than on an establishment basis.

1. Corn
2. Sorghum
3. Wheat
4. Other Grains
5. Soybeans
6. Hay
7. Dairying
8. Poultry
9. Cattle
10. Hogs
11. Other Ag. Products

12. Agricultural Services–Includes establishments primarily engaged in performing soil preparation services, crop services, veterinary services, other animal services, farm labor and management services, and landscape and horticultural services for others on a fee or contract basis. SIC 07

Mining

13. Crude Petroleum and Natural Gas–Includes establishments engaged in operating oil and gas field properties. SIC 1311

14. Oil and Gas Field Services–Establishments primarily engaged in drilling wells for oil or gas field operations for others and establishments performing geophysical, geological, and other exploration services for oil and gas, on a contract, fee, or similar basis. SIC 138

15. Nonmetallic Mineral Mining, excluding Fuels–Establishments primarily engaged in mining or quarrying, developing mines, or exploring for nonmetallic minerals, except fuels. SIC 14

16. Other Mining–Includes mining of coal, metals, and other minerals not previously classified. SIC 10, 12, 132

Construction

17. Maintenance and Repair–Includes expenditures by firms for maintenance and repair services on capital assets.

18. Building Construction–Includes general contractors engaged in construction of residential, farm, industrial, public, and other buildings. SIC 15

19. Heavy Construction–Includes general contractors engaged in the construction of highways and streets, bridges, sewers, railroads, etc. SIC 16

20. Special Trade Contractors–Includes contractors specializing in activities such as plumbing, painting, plastering, carpentering, etc. SIC 17

The accounting conventions used in the construction of the transactions matrix are as follows:

1. For each industry or sector in the state economy, the flows in the transactions matrix represent purchases from and sales to the other sectors valued in 1985 prices.

2. All transactions are valued in producers' prices rather than purchasers' prices. The difference between the former and the latter are marketing and related costs. Individual marketing costs, such as transportation and retail and wholesale trade purchases, are charged to the purchaser as a direct purchase from those sectors rather than as part of the purchase price of the basic commodity. In other words, if Industry Y buys an input from Industry X, which has an f.o.b. price of $10, and it costs $1 to ship it from X to Y, this shows up in the transactions matrix as a purchase of $10 from Industry X by Industry Y and a purchase of $1 of services from the transportation industry, regardless of which industry actually paid for the transportation.

3. The output and associated transactions of the retail and wholesale sectors are treated on a gross margin basis, which is roughly gross sales minus cost of goods sold. For instance, if a machinery manufacturer purchases fabricated metal parts from a wholesaler, the transaction is treated as if the machinery

Manufacturing

21. Meat Products–Includes establishments processing, preparing, and packing meat products. SIC 201

22. Dairy Products–Includes establishments processing milk, cream, cheese, butter, etc. SIC 202

23. Grain Mill Products–Includes establishments processing flour, cereal, feeds, etc. SIC 204

24. Other Food and Kindred Products–Includes establishments producing or processing beverage products, bakery products, etc. SIC 203, 205, 206, 207, 208, 209

25. Apparel and Related Products–Includes establishments producing clothing and fabricating products by cutting and sewing purchased woven or knit textile fabrics and related materials. SIC 23

26. Paper and Allied Products–Includes establishments manufacturing pulp from wood and other cellulose fibers, and manufacturing paper and paper products such as bags, boxes, envelopes, etc. SIC 26

27. Printing and Publishing–Includes establishments engaged in printing by one or more of the common processes, such as letterpress, lithography, gravure, or screen; establishments that perform services for the printing trade such as bookbinding, typesetting, and photoengraving. SIC 27

28. Industrial Inorganic and Organic Chemicals–Includes establishments engaged in manufacturing basic industrial chemicals such as industrial gases, dyes, pigments, etc. SIC 281, 286

29. Agricultural Chemicals–Includes establishments engaged in manufacturing fertilizers, agricultural pesticides, and other agricultural chemicals. SIC 287

30. Other Chemicals and Chemical Products–Includes establishments manufacturing unfinished plastics, drugs, cleaning preparations, perfumes, paints, explosives, glue, ink, etc. SIC 282, 283, 284, 285, 289

31. Petroleum and Coal Products–Includes establishments primarily engaged in petroleum refining, manufacturing paving and roofing materials, and compounding lubricating oils and greases from purchased materials. SIC 29

32. Rubber and Plastic Products–Includes establishments manufacturing rubber products such as tires, rubber footwear, mechanical rubber goods, flooring, etc., and establishments manufacturing primary plastic products and miscellaneous plastics products. SIC 30

33. Cement, Concrete and Plaster Products–Includes establishments producing hydraulic cement, concrete, concrete products, plasterboard, etc. SIC 324, 327

34. Other Stone, Clay, and Glass Products–Includes establishments producing glass and glass products, brick, pottery, etc. SIC 321, 322, 323, 325, 326, 328, 329

35. Primary Metal Industries–Includes establishments engaged in the smelting and refining of ferrous and nonferrous metals. SIC 33

36. Fabricated Structural Metal Products–Includes establishments engaged in manufacturing fabricated iron and steel for structural purposes such as metal sash and doors, sheet metal work, boiler plate fabrication, etc. SIC 344

37. Other Fabricated Metal Products–Includes establishments producing nonstructural metal products such as tools, containers, fasteners, stampings, wire, pipe, etc. SIC 341, 342, 343, 345, 346, 347, 348, 349

manufacturer bought a marketing service from the wholesaler (the wholesaler's margin) and the parts from the fabricated metal products industry.

4. The columns showing purchases by industries include only purchases used in current production; they exclude capital expenditures. The capital that is "used up" in current production appears as depreciation and is included in the gross savings sector. For industries producing and selling capital goods, the capital good production is shown as a sale to gross investment.

5. The entire output of an establishment is attributed to the industry of the establishment's primary output. Although this is consistent with standard reporting procedures, it gives rise to heterogeneity in industry groups. For instance, if an establishment that produces primarily meat products also produces soap, the total output is assigned to the meat products sector. The farming sectors are an exception to this accounting procedure, because they are on a commodity basis, not an establishment basis.

6. Although a base year was established, there were a few deviations for "abnormal" situations. The most significant of these occurred in the farming sectors, where some averaging was done to smooth extreme inventory swings.

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38. Farm Machinery and Equipment–Includes establishments engaged in manufacturing farm machinery and equipment. SIC 352

39. Construction and Industrial Machinery–Includes establishments engaged in manufacturing heavy machinery and equipment used by the construction, manufacturing, and mining industries. SIC 353

40. Food Products and Special Industry Machinery–Includes establishments manufacturing feed mill equipment, flour mill equipment, power saws, printing equipment, food packing machinery, etc. SIC 355

41. Electrical Machinery–Includes establishments engaged in manufacturing machinery, apparatus, and supplies for the generation, storage, transmission, transformation, and utilization of electrical energy. SIC 36

42. Other Machinery–Includes establishments manufacturing engines and turbines, machine tools, computing and accounting equipment, industrial machinery, etc. SIC 351, 354, 356, 357, 358, 359

43. Motor Vehicles and Equipment–Includes establishments manufacturing or assembling motor vehicles, passenger cars, truck and bus bodies, truck trailers, and parts for motor vehicles. SIC 371

44. Aerospace–Includes establishments manufacturing or assembling aircraft, missiles, or space vehicles and parts for such vehicles. SIC 372

45. Trailer Coaches–Establishments engaged in manufacturing trailer coaches, motor homes, and mobile homes. SIC 3792, 2451

46. Other Transportation Equipment–Includes establishments manufacturing transportation equipment not elsewhere classified. SIC 373, 375, 3799

47. Other Manufacturing–Includes establishments manufacturing goods not elsewhere classified such as textile mill products, lumber and wood products, furniture and fixtures, leather and leather products, scientific instruments, office supplies. SIC 21, 22, 24, 25, 31, 38

Transportation

48. Railroad Transportation–Includes establishments furnishing transportation by line-haul railroad, as well as REA Express and switching and terminal establishments. SIC 40

49. Motor Freight Transportation–Includes establishments furnishing local or long-distance trucking or transfer services or those engaged in the storage of farm products, furniture, and other household goods or commercial goods of any nature. SIC 42

50. Other Transportation–Includes transportation services not elsewhere classified. SIC 41, 44, 45, 46, 47

Utilities

51. Communication–Includes establishments furnishing point-to-point communication services, whether by wire or radio and whether intended to be received aurally or visually, and radio and television broadcasting. SIC 48

52. Electric, Gas, and Sanitary Services–Includes establishments engaged in supplying electricity, natural gas, and other gas products, water, garbage collection, and other sanitary services. SIC 49

Wholesale Trade

53. Groceries and Related Products–Includes establishments engaged in the wholesale distribution of a general line of groceries. SIC 514

54. Farm Product Raw Materials–Includes establishments engaged in buying and/or marketing farm product raw materials. SIC 515

55. Machinery, Equipment and Supplies–Includes establishments engaged in wholesaling machinery, equipment, and supplies. SIC 508

56. Other Wholesale Trade–Includes wholesalers not elsewhere classified. SIC 501, 502, 503, 504, 505, 506, 507, 509, 511, 512, 513, 516, 517, 518, 519

Retail Trade

57. Farm Equipment Dealers–Includes establishments engaged in marketing agricultural machinery and equipment. SIC 5083

58. Gasoline Service Stations–Includes establishments engaged in selling gasoline and lubricating oils and possibly selling other merchandise or performing minor repair work. SIC 554

59. Eating and Drinking Places–Includes establishments selling prepared foods and drinks for consumption on the premises. SIC 58

60. Other Retail Trade–Includes retail trade establishments not elsewhere classified. SIC 52, 53, 54, 55 (except 554), 56, 57, 59

Finance, Insurance, and Real Estate

61. Banking–Includes institutions that are engaged in deposit banking or closely related functions, including fiduciary activities. SIC 60

62. Other Financial Institutions–Includes credit and lending institutions other than banks, as well as security and commodity dealers, investment companies, etc. SIC 61, 62, 67

63. Insurance and Real Estate–Includes insurance carriers, agents, and insurance services, as well as real estate operators, agents, and real estate services. SIC 63, 64, 65, 66

Services

64. Lodging Services–Includes commercial and institutional establishments engaged in furnishing lodging, lodging and meals, and camping space and camping facilities on a fee basis. SIC 70

65. Personal Services–Includes establishments engaged in providing services, generally involving the care of the person or his/her apparel. SIC 72

66. Business Services–Includes establishments engaged in rendering services, not elsewhere classified, to business establishments on a fee or contract basis including advertising, maintenance services, employment services, equipment rental and leasing, and consulting services. SIC 73

67. Medical and Other Health Services–Includes establishments engaged in furnishing medical, surgical, and other health services to persons. SIC 80

68. Other Services–Includes establishments providing services not elsewhere classified including legal services, repair services, entertainment services, etc. SIC 75, 76, 78, 79, 82 (part), 83, 84, 86, 89

Final Payments

Households–Personal income paid to Kansas residents by industry or sector.

Gross Saving–Retained earnings and depreciation of industries and savings of households.

Federal Government–Payments made by industries and sectors to the federal government, mostly in the form of taxes and fees.

State Government–Payments made by industries and sectors to the state government, mostly in the form of taxes and fees.

Local Government–Payments made by industries and sectors to local governments, mostly in the form of taxes and fees.

Imports–Purchases made from out-of-state sources by Kansas industries, sectors, and households.

Final Demand

Households–Purchases, payments, and saving of Kansas households.

Gross Investment–Spending for capital goods by Kansas industries, sectors, and households.

Federal Government-Defense–Receipts of Kansas industries, sectors, and households from the sale of goods and services to federal government military activities.

Federal Government-Nondefense–Receipts of Kansas industries, sectors, and households from the federal government, other than for military activities, for the sale of goods and services and from transfer payments.

State Government–Receipts of Kansas industries, sectors, and households from state government for the sale of goods and services and from transfer payments.

Local Government–Receipts of Kansas industries, sectors, and households from local governments for the sale of goods and services and from transfer payments.

Exports–Receipts from the sale of Kansas goods and services to out-of-state customers.

The 1985 Model

The transactions matrix; the direct requirements matrix; the direct and indirect requirements matrix; and the direct, indirect, and induced requirements matrix are contained in the Appendix.

A variety of multipliers can be calculated from the input-output matrices. Two of these, output multipliers and income multipliers, appear in Tables 5 and 6, respectively. The output multipliers have been calculated by summing the first 68 rows of the direct, indirect, and induced requirements matrix. The income multipliers have been calculated by dividing the values in the household row of the direct, indirect, and induced matrix by their corresponding values in the household row of the direct requirements matrix.

Table 5. Output Multipliers

Sector	Multiplier	Sector	Multiplier
1 Corn	2.36787	35 Primary Metals	2.48711
2 Sorghum	2.40626	36 Fabricated Metal	2.60004
3 Wheat	2.68565	37 Other Fab Metal	2.37941
4 Other Grains	2.57884	38 Farm Machinery	2.56500
5 Soybeans	2.43995	39 Constr Mach	2.13583
6 Hay	2.42897	40 Food/Spec Mach	2.26411
7 Dairy	2.88155	41 Electrical Mach	2.42435
8 Poultry	2.78757	42 Other Machinery	2.36906
9 Cattle	2.86560	43 Motor Vehicles	1.61913
10 Hogs	2.87281	44 Aerospace	1.97054
11 Other Ag Prod	2.40708	45 Trailers	2.79384
12 Ag Services	2.04807	46 Other Transp Eq	2.25230
13 Oil/Gas Mining	1.92337	47 Other Mfg	1.92310
14 Oil/Gas Field Sv	2.56543	48 RR Transp	2.46325
15 Nonmetallic Mining	1.91438	49 Motor Freight	2.27164
16 Other Mining	2.87500	50 Other Transp	2.35297
17 Maint & Repair	3.57101	51 Communications	2.19207
18 Building Constr	2.78336	52 Elec/Gas SanSr	1.65651
19 Heavy Constr	2.76500	53 Grocery Whlse	2.80453
20 Spec Trade Constr	2.57101	54 Farm Prod Whlse	2.29440
21 Meat Products	2.64948	55 Mach/Equip Whlse	2.74106
22 Dairy Products	3.07742	56 Other Whlse	2.55741
23 Grain Mill Prod	2.87403	57 Farm Eq Dealers	2.60263
24 Other Food Prod	2.29645	58 Gas Serv Stations	2.21335
25 Apparel	1.49376	59 Eating/Drink Pl	2.59521
26 Paper Prod	2.22648	60 Other Retail	2.81019
27 Printing & Publ	1.86740	61 Banking	2.62159
28 Industrial Chem	2.72962	62 Other Finance	2.48265
29 Ag Chemicals	2.02230	63 Ins/Real Estate	2.67807
30 Other Chemicals	1.83617	64 Lodging	2.35234
31 Petroleum/Coal	2.33287	65 Personal Services	2.30800
32 Rubber/Plastic	1.84322	66 Business Services	2.39703
33 Cement/Concrete	2.55638	67 Medical/Health	2.35656
34 Other Stone/Clay	2.55732	68 Other Services	2.32304

Table 6. Income Multipliers

Sector	Multiplier	Sector	Multiplier
1 Corn	2.11992	35 Primary Metals	2.25978
2 Sorghum	1.94470	36 Fabricated Metal	1.87419
3 Wheat	1.88577	37 Other Fab Metal	1.67430
4 Other Grains	1.89421	38 Farm Machinery	2.73357
5 Soybeans	2.07337	39 Constr Mach	2.21950
6 Hay	1.56723	40 Food/Spec Mach	2.05730
7 Dairy	2.87098	41 Electrical Mach	2.08278
8 Poultry	2.58300	42 Other Machinery	2.38891
9 Cattle	4.40418	43 Motor Vehicles	2.05705
10 Hogs	4.83671	44 Aerospace	1.46700
11 Other Ag Prod	2.77216	45 Trailers	2.74491
12 Ag Services	1.61201	46 Other Transp Eq	1.92021
13 Oil/Gas Mining	3.31077	47 Other Mfg	1.49373
14 Oil/Gas Field Sv	3.05761	48 RR Transp	1.47953
15 Nonmetallic Mining	3.30343	49 Motor Freight	1.52623
16 Other Mining	2.00543	50 Other Transp	1.55312
17 Maint & Repair	0.00000	51 Communications	1.41062
18 Building Constr	3.31942	52 Elec/Gas/SanSr	1.99157
19 Heavy Constr	1.97332	53 Grocery Whlse	1.59501
20 Spec Trade Constr	1.57119	54 Farm Prod Whlse	1.69934
21 Meat Products	6.72038	55 Mach/Equip Whlse	1.67569
22 Dairy Products	4.94374	56 Other Whlse	1.59807
23 Grain Mill Prd	6.38474	57 Farm Eq Dealers	1.57980
24 Other Food Prd	2.92882	58 Gas Serv Stations	1.48425
25 Apparel	2.67513	59 Eating/Drink Pl	2.02964
26 Paper Prod	2.62052	60 Other Retail	1.93791
27 Printing & Publ	1.67390	61 Banking	1.67154
28 Industrial Chem	2.82406	62 Other Finance	1.72476
29 Ag Chemicals	2.25504	63 Ins/Real Estate	1.87753
30 Other Chemicals	2.00068	64 Lodging	2.03406
31 Petroleum/Coal	8.56420	65 Personal Services	1.69426
32 Rubber/Plastic	1.86227	66 Business Services	1.73359
33 Cement/Concrete	1.77632	67 Medical/Health	1.47504
34 Other Stone/Clay	2.33167	68 Other Services	1.38953

Publications Related to Kansas Input-Output Models

Emerson, M. Jarvin. 1966-1978. Third-Fifteenth Annual Governor's Economic Reports. Kansas Office Econ. Anal., Topeka.

_____ . 1969. The Interindustry Structure of the Kansas Economy. Kansas Office of Econ. Anal. and Kansas Dept. of Econ. Dev. Topeka.

_____ . 1971. An Interindustry Comparison of Regional and National Economic Structure. Pap. Reg. Sci. Assoc. 27: 165-77.

_____. 1971. Interindustry Projections of the Kansas Economy. Dept. Econ., Kansas State Univ.; Kansas Office Econ. Anal.; and Kansas Water Res. Board.

_____. 1971. The 1969 Kansas Input-Output Study. State of Kansas.

_____ . 1974. Business and Industrial Resources. Chap. 10 in: *The Future of Kansas Study.* Inst. Soc. and Envir. Stud., Univ. Kansas, Lawrence.

_____ . 1974. Large Scale Models in Regional Development Planning. Reg. Sci. Persp. 4: 1-17.

_____ . 1974. Regional Analysis and Projections: Economic Activity. Chap. 4 in: *Economic Development Plans for Kansas.* Ozarks Reg. Comm., Little Rock, Ark.

_____. 1974. The Future of the Kansas Economy. Kansas Dept. Econ. Dev. and Ozarks Reg. Comm., Little Rock, Ark.

_____. 1976. Interregional Trade Effects in Static and Dynamic Input-Output Models. Chap. 13 in: *Advances in Input-Output Analysis.* Polenske and Skolka (eds.). Ballinger, Boston, MA.

_____. 1979-1982. Economic & Social Report of the Governor. Office of the Governor, Topeka.

_____ . 1979. The State of the State: 1978-80. Kansas Bus. Rev. April: 4-6.

_____ . 1984. Modeling Resource Depletion Impacts—The Ogallala Aquifer Study. Socio-Econ. Planning Sci. 18 (5): 76-83.

_____ , H. Akhavipour, and B. Walther. 1982. Ogallala Aquifer Study in Kansas–Input-Output Model. Kansas Water Office, Topeka.

_____ and S. Carey. 1983. Relationships between Regional Economic Development and Regional Economic Structure. Chap. 10 in: *Essays in Regional Economic Studies,* J. Dutta (ed.). Acorn Press, Durham, NC.

_____ and D. Daicoff. 1983, 1984, 1985, 1986. The Kansas Economic Report. Kansas State Univ., Manhattan and Univ. Kansas, Lawrence.

_____ and M. Hackbart. 1970. A Note on the Stability of Labor Coefficients. Ann. Reg. Sci. Dec.: 27-32.

_____ and M. Henry. 1972. The Impact of the Public Sector on the Growth of the Kansas Economy in: *State and Local Finance in Kansas.* Univ. Kansas and Kansas State Univ.

_____ and T. L. Hunt. 1983. Elasticities of Substitution in Regional Production Functions. Rev. Reg. Stud. 13 (3): 12-17.

_____ and F. C. Lamphear. 1975. *Urban and Regional Economics.* Allyn and Bacon, Boston, MA.

_____, F. C. Lamphear, and L. D. Atencio. 1969. Towards a Dynamic Export Forecasting Model. Ann. Reg. Sci. 4 (1): 127-138.

_____ and K. Lemke. 1975. Energy Consumption, Conservations and Conversion in Kansas Commercial and Industrial Firms. Planning Div., Kansas Dept. Econ. Dev., Topeka.

_____ and J. D. Reed. 1971. The Interindustry Structure of the Wichita Economy. Kansas Office Econ. Anal., Topeka.

_____ and A. Ringleb. 1978. A Comparison of Regional Interindustry Structures. Pap. Reg. Sci. Assoc. 39: 85-98.

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