An Analysis of the Capital Structure By Private Sectors in Oklahoma

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Gerald A. Doeksen and Dean F. Schreiner*

Recent shifts in population have led to serious problems in both rural and urban areas. Migration from rural areas has resulted in a smaller base from which the remaining social and economic activities must be supported. Metropolitan areas receiving the increased population must expand socially and economically in order to support the increased population. The Nation's inability to cope with the shift in needs has resulted in discontent and riots in some cities and pockets of poverty in rural areas. Plant obsolescence, low skills of labor force, or deficiencies in social overhead capital suggests a "capital deficiency" hypothesis in explaining lagging development in some regions. [20, p.92]

Inability of regions to adjust to problems of changing technology, changing demand conditions and resource depletion further suggest deficiencies in human capital as well as the more physical forms of capital. [3] For an objective evaluation of alternative development strategies, more comprehensive models incorporating productivity changes and effects of capital investments on regional development need to be implemented. Cumberland [4, pp. 74-75] summarizes the need for capital inclusion as follows:

> "The universal pressures for regional development cannot be understood fully without analysis of the investment process and the role of the capital formation sector in the region."

Lack of data and methodology have resulted in few regional studies including data from a capital account in the analysis.[1] This research report presents the capital account of Oklahoma and explains in detail

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[1] Research reports by Zusman [41], Maki [22], and Spiegelman [28] contain regional capital accounts. Zusman constructed a capital account for California, while Maki and Spiegelman constructed only that part of the capital account required for their model.

the development of the data for the account. The capital data will be highly useful to fellow state researchers conducting either macro or micro studies. The macro economist should find the data useful in evaluating various development policies and programs, whereas the micro economist should find the data helpful in analyses of individual sectors of the economy. Fellow regional economists confronted with problems of constructing a regional capital account should find the report helpful in terms of methodology and documentation.

The Objectives of the Study

The primary objective of this study is to provide capital data of the private sectors in Oklahoma for researchers working with comprehensive planning models and for researchers working on individual sector projects. Hence, the report can be viewed as a document which provides data to be applied in later investigations. Specific objectives of the capital analysis include:

1) constructing a capital coefficient matrix, a capital unit matrix, a capital stock matrix, and an investment matrix;
2) deriving capital-output ratios applicable to Oklahoma;
3) estimating capacity levels for the private sectors in Oklahoma; and
4) determining inventory and depreciation coefficients for the Oklahoma economy.

To better understand the capital account as derived in this study, the concepts and definitions are developed and discussed below. Following this development, the capital data are presented, the methodology employed is discussed, and data sources are specified.

Concepts and Definitions Used in the Oklahoma Capital Account

The capital coefficient matrix forms the base of the Oklahoma capital analysis. It can be derived from a capital flow matrix or by using direct survey techniques. Construction of capital coefficients using survey data was completed by Waddel [40]. An illustration of construction of capital coefficients from a capital flow matrix is given by Alterman [1]. Both of these studies were employed in this analysis. A capital coefficient matrix computed from capital flows is given as:

$$w_{ij} = \frac{b_{ij}}{b_j}$$

where the b_{ij}'s are capital purchases of the j^{th} sector from the i^{th} sector

and b_j is the total capital purchases of the j^{th} sector. Each capital coefficient (w_{ij}) indicates the amount of capital goods required from the i^{th} sector per dollar's worth of capital expenditures by the j^{th} sector.

A capital stock matrix can be computed from the capital coefficient matrix and sector capital-output ratios. Capital-output ratios (K/X) for this analysis are defined as the ratio of total cost of plant and equipment to output at capacity. For this analysis, capacity is defined as that output equal to peak production. Once capacity output X_j^c is defined, the total amount of capital in each sector can be estimated. The procedure is as follows:

$$X_j^c(K/X)_j = K_j$$

where X_j^c is output at capacity for sector j and $(K/X)_j$ is the capital-output ratio for sector j. The capital stock matrix can then be determined by multiplying total sector capital stock estimates (K_j) by the capital coefficient matrix, that is:

$$K_j \cdot w_{ij} = K_{ij}$$

where each K_{ij} represents the total amount of capital goods from sector i invested in sector j.

Some researchers desire to know the amount of capital invested and the composition of that capital per unit of output capacity[2] of the producing sector. A matrix yielding this information is referred to as the capital unit coefficient matrix. It is computed as follows:

$$(K/X)_j \cdot w_{ij} = o_{ij}$$

where $(K/X)_j$ is the capital-output ratio of sector j and w_{ij} is the capital coefficient. Each coefficient (o_{ij}) indicates the amount of capital needed from the i^{th} sector to provide one unit of output capacity for the j^{th} sector.

Another matrix of importance is the investment coefficient matrix. By adding the capital unit coefficients and the inventory coefficients for a sector, the total amount of capital required per unit of output expansion is estimated. The investment coefficient matrix is calculated as follows:

$$\frac{\Sigma_i(O_{ij}+S_{ij})}{O_{ij}+S_{ij}} = I_{ij}$$

where $(O_{ij}+S_{ij})$ is the combined capital unit matrix and inventory coefficient matrix. Each I_{ij} indicates the value of output of the i^{th} sector required by the j^{th} sector per unit of investment in j. The difference between the investment coefficient matrix and the capital coefficient

[2] Unit of output is in dollars.

matrix is that inventory estimates are included in this matrix. Inventory coefficients are defined as the amount of inventory held per unit of output.

The capital analysis is completed by developing depreciation coefficients. The coefficients d_j indicate the depreciation rate per dollar of depreciable assets:

$$d_j = \frac{D_j}{K_j}$$

where D_j is the total annual depreciation of capital stock in sector j.

The Oklahoma Capital Account

The sectors included in the Oklahoma capital analysis are listed in Table 1. In all, 27 sectors are included, of which 19 are manufacturing sectors and two are agricultural sectors. The remaining sectors represent maining; construction; retail and wholesale; transportation, communication and public utilities; real estate, finance, and insurance, and service.

Table 1. Sector Classification of the Oklahoma Economy

Oklahoma Code	SIC Code	Industry
1		Livestock and Livestock Products
2		Crops
3	10-14	Mining
4	15-17	Construction
5	20	Food and Kindred Products
6	22	Textile Mill Products
7	23	Apparel and Related Products
8	24	Lumber and Wood Products
9	25	Furniture and Fixtures
10	26	Paper and Allied Products
11	27	Printing and Publishing
12	28	Chemicals and Allied Products
13	29	Petroleum and Coal Products
14	30	Rubber and Plastics Products
15	31	Leather and Leather Products
16	32	Stone, Clay and Glass Products
17	33	Primary Metal Industries
18	34	Fabricated Metal Products
19	35	Machinery, Except Electrical
20	36	Electrical Machinery
21	37	Transportation Equipment
22	38	Instruments and Related Products
23	39	Miscellaneous Manufacturing
24	40-49	Transportation, Communication, and Public Utilities
25	50-59	Wholesale and Retail Trade
26	60-69	Finance, Insurance, and Real Estate
27	70-89	Services

Capital Coefficient Matrix

Until recently, researchers needing capital coefficients relied on data obtained in the late 40's and early 50's. The primary source was a study conducted by Robert N. Grosse [11]. Data for this analysis were obtained from studies prepared by several government agencies and universities participating in the Inter-industry Economics Research Program (1948-54) sponsored by the U.S. Air Force. The capital requirements presented by Grosse were for the year 1947 and were based mainly on new plants or expansions of existing plants. One weakness of these data is that the studies covered only a small and not necessarily representative set of plants. Another weakness is that the technology represented in the studies has by now become seriously out of date.

The Agency for International Development provided a more recent source [36 and 37] of capital data. Again these data are deficient in several ways. Capital coefficients were designed for small scale and simplified industrial operations. They also represented technologies adaptable for initial industrialization in developing countries rather than for the United States.

Two other research projects have measured the country's capital requirements. These include the McGraw-Hill Capital Expenditure Surveys [23] and the Harvard Economic Capital Research Project [12]. The Harvard project was for the year 1947 and thus is somewhat dated, whereas the McGraw-Hill estimates are for broad sectors and used mainly in national studies. In some of his studies Eisner [6 and 7] used the McGraw-Hill expenditure data.

Oklahoma Capital Coefficient Matrix

The research gap created since emergence of the above dated capital studies was met by Waddel and others [40]. This study yielded capital coefficient for 252 manufacturing groups. The manufacturing industry groups were classified according to the four digit standard industrial classification and the data were for the year 1963. Thus, this source yielded coefficients which are the latest and most detailed. The 252 manufacturing industry groups were aggregated to represent the 19 Oklahoma manufacturing sectors. The aggregation was accomplished in two steps. First, the purchases of each four digit industrial group were aggregated to the two digit level.

The number of computations for this task were very large as the National Planning Association classified many purchases as modules. The module concept was used to simplify the presentation of the capital data, but for the Oklahoma capital analysis, the composition of each

module had to be determined. After determining module composition, a two digit industrial classification of inputs for each four digit industrial group was obtained.

A second step in the aggregation process consisted of aggregating the four digit industrial groups to the two digit industrial classification. Value of shipments as reported in the 1963 Census of Manufacturing were used as weights. In some instances, census data on the value of shipments are incomplete and the more available employment data were used.

The non-manufacturing sectors were not included in the National Planning Association study. Capital coefficients for the non-manufacturing sectors were developed from a study by the U.S. Department of Labor [1]. This study used the Census of Manufacturers and additional estimates from the Office of Business Economics to estimate the level of capital production by industry and to allocate to consuming sectors. Consumption of capital goods represented purchases made for replacement as well as for new plant construction. This analysis differed from Waddel's [40] and needed to be adjusted in order to have consistent coefficients for all sectors. Waddel's analysis distributed the expenditures going to the construction sector back to input originating sectors, whereas the U.S. Department of Labor's analysis shows only construction expenditures. Thus, Waddel's capital coefficient matrix has a value added row which includes wages and salaries, profits, depreciation, etc., going to the construction sector. In order to make the Department of Labor's analysis similar to Waddel's, the expenditures for construction were allocated to the various sectors according to the construction modules developed by Waddel [40].

Capital coefficients for the Oklahoma economy are presented in Table 2. By reading down a column, the purchases of capital goods from the producing sectors per dollar of capital investment by that sector are determined. For instance, per dollar investment by sector 1 (crop), .00085 dollars of capital goods are purchased from sector 3 (mining), .01485 dollars from sector 8 (lumber and wood products), etc.

Capital-Output Ratios

To analyze the relationship between capital and output, either the marginal ratio or average ratio can be used. Since output has been increasing, the directional movement of one ratio can be inferred from the other. For this analysis, capital-output ratios are used as averages and defined as the ratio of total cost of plant and equipment to output at capacity. The sources and techniques used to derive the capital-output ratios for Oklahoma are presented below. The presentation is divided

into three parts; (1) capital-output ratios for manufacturing sectors, (2) capital-output ratios for the agricultural sectors, and (3) capital-output ratios for the remaining sectors.

Manufacturing Sectors

The relationship between capital and output is discussed in detail by Creamer, Dobrovolshy, and Borenstein [3]. Their analysis studies the movement of capital-output ratios in manufacturing from 1880-1953 and in mining from 1870-1953. Another important source for data on capital-output ratios for manufacturing sectors was completed by Kuznets [18]. Both Creamer and Kuznets used data published by the Internal Revenue Service [39] as the primary source of data since 1919. Several other publications report results from determining the capital structure of manufacturing. Included are works completed by Hildebrand and Liu [14], Stigler [29], and Hickman [13]. Hildebrand and Liu in their analysis determined the marginal physical product and the marginal revenue product of capital. Stigler computed capital-output ratios for various manufacturing sectors. He calculated a capital-output ratio for a small and large plant in each sector for 1947 and 1954. Hickman developed an investment model from which he calculated long-run capital-output ratios.

The National Planning Association [40] provides the most recent capital-output ratios and the most comprehensive. A determining factor in using it to derive capital-output ratios for Oklahoma was its comprehensiveness. This study provided capital-output ratios for 252 manufacturing sectors for 1963. The 252 industries were classified according to the four digit industrial classification. In order to adapt these ratios to the two digit classification used in the Oklahoma model, a weighting procedure was used. To reflect the Oklahoma economy, value of shipments as reported in the Census of Manufacturing were used as weights and capital-output ratios derived for the 19 manufacturing sectors. The capital-output ratios are presented in Table 3.

Agricultural Sectors

The capital-output ratio for the two agricultural sectors was developed separately since a ratio for the Texas-Oklahoma region was estimated by Tostlebe [30]. His capital-output ratio for the Texas-Oklahoma region for 1950 was 4.02 when the value of land was included as capital and 1.21 when capital was defined as reproducible assets, [30, pages 108, 109, and 117]. The change in the capital-output ratio from 1950 to 1963 was estimated by Kendrick [15, p. 170]. These sources yielded a reproducible

Table 2. Capital Coefficient Matrix by Major Industry Group for Oklahoma, 1963.

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agricultural Sectors	1+2	.61298	.00000	.00000	.00000	.00033	.00040	.00038	.00043	.00041	.00040	.00030	.00044	.00050	.00043
Mining	3	.00058	.00085	.00010	.00206	.00365	.00432	.00412	.00414	.00443	.00434	.00327	.00451	.00461	.00449
Textile Mill Products	6	.00000	.00000	.00000	.00000	.00017	.00022	.00022	.00024	.00022	.00022	.00018	.00023	.00026	.00023
Lumber and Wood Prod.	8	.01045	.01485	.00173	.03520	.02730	.03360	.03998	.03098	.03700	.03229	.03103	.02880	.01562	.02549
Furniture and Fixtures	9	.00018	.00043	.00623	.00210	.00154	.00101	.00171	.00099	.00139	.00106	.00168	.00093	.00066	.00095
Paper and Allied Prod.	10	.00146	.00213	.00026	.00517	.00110	.00146	.00106	.00057	.00109	.00117	.00111	.00070	.00030	.00108
Chemicals and Allied Prod.	12	.00079	.00116	.00014	.00281	.00447	.00466	.00450	.00457	.00455	.00462	.00477	.00514	.00455	.00460
Petroleum and Coal Prod.	13	.00251	.00368	.00044	.00891	.00516	.00636	.00671	.00565	.00697	.00641	.00535	.00611	.00499	.00661
Rubber and Plastics Prod.	14	.00018	.00029	.00052	.00030	.00022	.00025	.00024	.00024	.00024	.00025	.00026	.00023	.00025	.00026
Leather and Leather Prod.	15	.00035	.00029	.00000	.01021	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Stone, Clay and Glass Prod.	16	.02952	.04324	.00523	.10480	.05874	.06530	.06684	.05983	.06830	.06555	.06292	.06428	.05872	.06354
Primary Metal Industries	17	.00896	.01312	.00159	.03179	.03365	.03668	.03459	.03933	.03526	.03570	.03470	.04433	.05400	.03756
Fabricated Metal Prod.	18	.03085	.04976	.01535	.09956	.06410	.06294	.05780	.08432	.05998	.06405	.06406	.08978	.12032	.07469
Machinery, Except Elect.	19	.09271	.40362	.59159	.26048	.25935	.29282	.09596	.25869	.26759	.29453	.30941	.22680	.16825	.28571
Electrical Machinery	20	.00508	.00892	.01927	.01824	.02540	.02533	.21685	.02773	.04583	.03080	.02340	.03449	.03390	.03482
Transportation Equipment	21	.06884	.16669	.18267	.04206	.10374	.01163	.01563	.02701	.01444	.00996	.01302	.01213	.02353	.00602
Instruments and Related Prod.	22	.00000	.00000	.00000	.00000	.00798	.00736	.00568	.00962	.00597	.00663	.00756	.01678	.02893	.00775
Misc. Manufac.	23	.00070	.00087	.00000	.00060	.00092	.00101	.00086	.00097	.00098	.00101	.00105	.00097	.00098	.00102
Transportation, Communication, and Public Util.	24	.00456	.01680	.02180	.00841	.01369	.01500	.01501	.01469	.01502	.01509	.01484	.01539	.01570	.01515
Wholesale and Retail	25	.03863	.14048	.13700	.04537	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Finance, Insurance and Real Estate	26	.00000	.00000	.00000	.00000	.03601	.03934	.03932	.03895	.03941	.03958	.03888	.04038	.04121	.03974
Services	27	.00000	.00000	.00000	.00000	.04415	.04826	.04821	.04781	.04832	.04853	.04766	.04959	.05052	.04872
Value Added Construction Sector		.09067	.13282	.01608	.32193	.30833	.34205	.34433	.34324	.34260	.33781	.33455	.35799	.37220	.34114
TOTAL		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 2. Cont'd.

Sectors	Oklahoma Code	15	16	17	18	19	20	21	22	23	24	25	26	27
Agricultural Sectors	1+2	.00040	.00037	.00043	.00039	.00036	.00042	.00043	.00041	.00036	.00000	.00000	.00000	.00000
Mining	3	.00433	.00372	.00413	.00394	.00414	.00457	.00444	.00430	.00388	.00157	.00101	.00162	.00154
Textile Mill Prod.	6	.00022	.00021	.00023	.00021	.00020	.00023	.00024	.00022	.00021	.00055	.00362	.00187	.00170
Lumber and Wood Prod.	8	.03400	.02221	.02400	.03018	.03133	.3240	.03701	.03468	.03005	.02639	.01694	.02723	.02594
Furniture and Fixtures	9	.00162	.00100	.00087	.00126	.00121	.00146	.00117	.00143	.00118	00912	.06154	.04388	.04040
Paper and Allied Prod.	10	.00180	.00066	.00030	.00044	.00081	.00092	.00073	.00105	.00104	.00395	.00253	.00407	.00388
Chemicals and Allied Prod.	12	.00461	.00484	.00488	.00471	.00477	.00455	.00472	.00454	.00465	.00214	.00137	.00221	.00210
Petroleum and Coal Prod.	13	.00638	.00509	.00498	.00537	.00622	.00687	.00632	.00683	.00609	.00680	.00436	.00701	.00668
Rubber and Plastics Prod.	14	.00024	.00026	.00027	.00023	.00024	.00023	.00024	.00024	.00025	.00013	.00724	.00023	.00051
Leather and Leather Prod.	15	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00051
Stone, Clay and Glass Prod.	16	.06558	.05672	.05925	.05712	.06155	.06768	.06471	.06887	.06597	.07993	.05130	.08246	.07856
Primary Metal Industries	17	.03650	.03646	.03968	.03285	.03212	.03532	.03492	.03681	.03268	.02425	.01556	.02502	.02384
Fabricated Metal Prod.	18	.06645	.08010	.09036	.07269	.06569	.06768	.06689	.06571	.05802	.11432	.05299	.09374	.08026
Machinery, Except Elect.	19	.26193	.29120	.27685	.29139	.30491	.25050	.28494	.24665	.30076	.07012	.19485	.16009	.10892
Electrical Machinery	20	.04579	.03097	.03207	.03609	.03535	.06481	.03385	.03129	.03809	.18414	.03367	.02281	.05656
Transportation Equip.	21	.01280	.02882	.00421	.02890	.01502	.00613	.01077	.00491	.01862	.14032	.21827	.15169	.19260
Instruments and Related Prod.	22	.00687	.00780	.00956	.00496	.00434	.00911	.00591	.03636	.00472	.00000	.00000	.00000	.00000
Misc. Manufac.	23	.00098	.00102	.00101	.00096	.00098	.00098	.00097	.00098	.00102	.00036	.02002	.00093	.02488
Transportation, Communication, and Public Util.	24	.01504	.01468	.01517	.01478	.01491	.01521	.01512	.01517	.01484	.04204	.01533	.01027	.01210
Wholesale and Retail	25	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.04832	.14182	.11155	.09767
Finance, Insurance and Real Estate	26	.03945	.03854	.03990	.03882	.03915	.03990	.03965	.03979	.03890	.00000	.00000	.00000	.00000
Services	27	.04838	.04724	.04886	.04760	.04803	.04892	.04863	.04880	.04770	.00000	.00000	.00000	.00000
Value Added Construction Sector		.34663	.32808	.34299	.32711	.32867	.34211	.33834	.35096	.33097	.24555	.15758	.25332	.24135
TOTAL		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 3. Capital-Output Ratios for the Manufacturing Sectors in Oklahoma, 1963.

Oklahoma Code	Sector	Capital-Output Ratio
5	Food and Kindred Products	.30160
6	Textile Mill Products	.42600
7	Apparel and Related Products	.12157
8	Lumber and Wood Products	.53318
9	Furniture and Fixtures	.35800
10	Paper and Allied Products	.52309
11	Printing and Publishing	.49000
12	Chemicals and Allied Products	.66950
13	Petroleum and Coal Products	.85000
14	Rubber and Plastic Products	.46993
15	Leather and Leather Products	.18337
16	Stone, Clay, and Glass Products	.68337
17	Primary Metal Industries	.58382
18	Fabricated Metal Products	.43576
19	Machinery, Except Electrical	.48555
20	Electrical Machinery	.29405
21	Transportation Equipment	.29469
22	Instruments and Related Products	.33634
23	Miscellaneous Manufacturing	.63251

capital-output ratio for agriculture of 1.36609 for 1963. This ratio was based on a definition of average output and with capacity estimates[3] it was converted to a capital-output ratio based on output defined as capacity output. Both ratios are presented in Table 4.

Remaining Sectors[4]

Capital-output ratios for the remaining sectors were not available for Oklahoma and hence national capital-output ratios were used. Three additional problems resulted. First, national ratios were not available for 1963. Second, national ratios were based on different sector classifications. Third, national ratios were developed with different definitions for capital and output. Differences in base year could have been handled since Creamer [3], Leontief [19, p. 407], and Hickman [13, p. 152] provided capital-output ratios for the remaining sectors for 1953, 1947, and 1962 respectively. These ratios plus annual changes in capital-output ratios provided by Egbert [5, p. 407] and Kendrick [15, p. 271] would have yielded ratios for 1963. However, problems 2 and 3 could not be solved since different sector classifications and term definitions were used in the above studies.

[3] Capacity estimates and procedure used to derive them are presented in a later section.
[4] Remaining sectors include mining; construction; transportation, communication, and public utilities, finance, real estate, and nsurance; wholesale and retail trade; and services.

Table 4. Capital-Output Ratios for the Non-manufacturing Sectors in Oklahoma, 1963.

Oklahoma Code	Sector	Capital-Output Ratios[1] I	II
1	Livestock and Livestock Products	1.36609	1.30831
2	Crops	1.36609	1.30831
3	Mining	1.03068	.95534
4	Construction	.19259	.18358
24	Transportation, Communication, and Public Utilities	2.32469	2.22868
25	Wholesale and Retail	.51897	.49017
26	Finance, Insurance, and Real Estate	1.05314	1.03397
27	Services	.51244	.48036

[1] The type I capital-output ratio is defined at average output, whereas the type II ratio is defined at capacity output.

Sector classification used in this study was presented in Table 1. The definition used in this study of output is similar to that used in construction of the current transaction Table for Oklahoma.[5] In general, output for the remaining sectors is defined as the value of receipts. The one exception is in the wholesale and retail trade sector where output is defined as the value of receipts minus the cost of goods sold. The definition for capital is net capital stock which is defined as capital stock after deduction of depreciation. Capital and output data for 1963 consistent with these definitions and sector classification were available from IRS data [38].

The capital-output ratios for the remaining sectors are presented in column (1) of Table 4. These capital-output ratios are based on a definition of capital to average output rather than output at capacity, as are the capital output ratios of the manufacturing sectors presented in Table 3. Thus, capacity estimates for the remaining sectors were used to derive capital-output ratios with output defined as capacity output. These ratios are presented in column (2) in Table 4.

Capital Unit Matrix

The capital coefficients and the capital-output ratios can be used to construct a capital unit matrix. Each coefficient (O_{ij}) in this matrix indicates the capital goods required from sector i to produce one unit of output capacity for sector j. The coefficients (O_{ij}) are computed by multiplying the capital coefficients of sector j from Table 2 by the capital-output ratio for sector j.

[5] For definition of specific sectors see Gerald A. Docksen. A social accounting system and simulation model projecting economic variables and analyzing the structure of the Oklahoma Economy. Ph.D. Thesis, Oklahoma State University.

Table 5. Capital Unit Matrix by Major Industry Group for Oklahoma, 1963.

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agricultural Sectors	1+2	.80197	.00000	.00000	.00000	.00010	.00017	.00005	.00023	.00015	.00021	.00015	.00029	.00043	.00020
Mining	3	.00076	.00111	.00010	.00038	.00110	.00184	.00050	.00221	.00158	.00227	.00160	.00302	.00392	.00211
Textile Mill Products	6	.00000	.00000	.00000	.00000	.00005	.00009	.00003	.00013	.00008	.00012	.00009	.00015	.00022	.00011
Lumber and Wood Prod.	8	.01367	.01943	.00165	.00646	.00823	.01431	.00486	.01652	.01327	.01689	.01521	.01928	.01328	.01198
Furniture and Fixtures	9	.00023	.00056	.00595	.00039	.00046	.00043	.00021	.00053	.00050	.00055	.00082	.00062	.00056	.00045
Paper and Allied Prod.	10	.00191	.00279	.00025	.00095	.00033	.00062	.00013	.00030	.00039	.00061	.00054	.00047	.00026	.00051
Chemicals and Allied Prod.	12	.00103	.00152	.00013	.00052	.00135	.00199	.00055	.00244	.00163	.00242	.00234	.00344	.00387	.00216
Petroleum and Coal Prod.	13	.00329	.00481	.00042	.00163	.00156	.00271	.00081	.00301	.00250	.00335	.00262	.00409	.00424	.00311
Rubber and Plastics Prod.	14	.00023	.00038	.00050	.00005	.00007	.00011	.00003	.00013	.00008	.00013	.00013	.00015	.00021	.00012
Leather and Leather Prod.	15	.00046	.00038	.00000	.00187	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Stone, Clay and Glass Prod.	16	.03862	.05657	.00500	.01924	.01771	.02782	.00813	.03190	.02445	.03429	.03083	.04304	.04991	.02986
Primary Metal Industries	17	.01172	.01717	.00152	.00584	.01015	.01563	.00421	.02097	.01262	.01867	.01700	.02968	.04590	.01765
Fabricated Metal Prod.	18	.04036	.06510	.01466	.01828	.01933	.02681	.00703	.04496	.02147	.03350	.03139	.06011	.10227	.03510
Machinery, Except Elect.	19	.12130	.52806	.56517	.04782	.07822	.12474	.01167	.13793	.09580	.15407	.15161	.15148	.14301	.13426
Electrical Machinery	20	.00664	.01167	.01841	.00335	.00768	.01079	.02636	.01479	.01641	.01611	.01147	.02309	.02882	.01636
Transportation Equipment	21	.09006	.21808	.17451	.00772	.03129	.00495	.00190	.01440	.00517	.00521	.00638	.00812	.02000	.00283
Instruments and Related Prod.	22	.00000	.00000	.00000	.00000	.00241	.00314	.00069	.00513	.00214	.00347	.00370	.01124	.02458	.00364
Miscellaneous Manufact.	23	.00092	.00114	.00000	.00011	.00028	.00043	.00010	.00052	.00035	.00053	.00051	.00065	.00083	.00048
Transportation, Communication, and Public Utility	24	.00597	.02198	.02083	.00154	.00413	.00639	.00183	.00783	.00537	.00790	.00727	.01030	.01334	.00712

Table 5. Cont'd.

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Wholesale and Retail	25	.05054	.18379	.13088	.00833	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Finance, Insurance and Real Estate	26	.00000	.00000	.00000	.00000	.01086	.01676	.00478	.02076	.01411	.02070	.01906	.02704	.03503	.01868
Services	27	.00000	.00000	.00000	.00000	.01331	.02056	.00586	.02548	.01729	.02539	.02335	.03321	.04294	.02289
Value Added Construction Sector		.11863	.17377	.01536	.05910	.09300	.14571	.04186	.18301	.12266	.17670	.16393	.23967	.31638	.16031
Capital-Output Ratio		1.30831	1.30831	.95534	.18358	.30160	.42600	.12159	.55318	.35807	.52309	.49000	.66950	.85000	.46993

Sectors	Oklahoma Code	15	16	17	18	19	20	21	22	23	24	25	26	27
Agricultural Sectors	1+2	.00008	.00025	.00025	.00017	.00017	.00012	.00013	.00014	.00023	.00000	.00000	.00000	.00000
Mining	3	.00076	.00254	.00241	.00172	.00201	.00134	.00131	.00145	.00245	.00350	.00050	.00168	.00074
Textile Mill Prod.	6	.00004	.00014	.00013	.00009	.00010	.00007	.00007	.00007	.00013	.00123	.00193	.00193	.00082
Lumber and Wood Prod.	8	.00440	.01518	.01401	.01315	.01521	.00953	.01091	.01166	.01901	.05881	.00830	.02816	.01246
Furniture and Fixtures	9	.00016	.00068	.00051	.00055	.00059	.00043	.00034	.00048	.00075	.02033	.03016	.04537	.01941
Paper and Allied Prod.	10	.00006	.00045	.00018	.00019	.00039	.00027	.00021	.00035	.00066	.00880	.00124	.00421	.00186
Chem. and Allied Prod.	12	.00089	.00331	.00285	.00205	.00232	.00134	.00139	.00153	.00294	.00477	.00067	.00229	.00101
Petroleum and Coal Prod.	13	.00091	.00348	.00291	.00234	.00302	.00202	.00186	.00230	.00385	.01516	.00214	.00725	.00321
Rubber and Plastics Prod.	14	.00005	.00018	.00016	.00010	.00012	.00007	.00007	.00008	.00016	.00029	.00355	.00024	.00024
Leather and Leather Prod.	15	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00024
Stone, Clay and Glass Prod.	16	.01086	.03876	.03459	.02489	.02988	.01990	.01907	.02316	.04173	.17814	.02515	.08526	.03774
Primary Metal Industries	17	.00728	.02492	.02317	.01431	.01560	.01039	.01029	.01238	.02067	.05405	.00763	.02687	.01145
Fabricated Metal Prod.	18	.01657	.05474	.05275	.03168	.03190	.01990	.01971	.02210	.03670	.25478	.02597	.09692	.03855
Machinery, Except Elect.	19	.05076	.19900	.16163	.12698	.14805	.07366	.08397	.08296	.19023	.15627	.09551	.16553	.05232
Electrical Machinery	20	.00588	.02116	.01872	.01573	.01716	.01906	.00998	.01052	.02409	.41039	.01650	.02358	.02717
Transportation Equip.	21	.00077	.01969	.00246	.01259	.00729	.00180	.00317	.00165	.01178	.31273	.10699	.15684	.09252
Instruments and Related Prod.	22	.00175	.00533	.00558	.00216	.00211	.00268	.00174	.01223	.00299	.00000	.00000	.00000	.00000
Miscellaneous Manufact.	23	.00018	.00070	.00059	.00042	.00048	.00029	.00028	.00033	.00064	.00080	.00931	.00096	.01195
Transportation, Communication, and Public Util.	24	.00279	.01004	.00885	.00644	.00724	.00447	.00440	.00511	.00939	.09369	.00752	.01062	.00581
Wholesale and Retail	25	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.10769	.06952	.11534	.04692
Finance, Insurance and Real Estate	26	.00731	.02634	.02329	.01692	.01901	.01173	.01169	.01337	.02460	.00000	.00000	.00000	.00000
Services	27	.00897	.03228	.02853	.02074	.02332	.01438	.01433	.01642	.03017	.00000	.00000	.00000	.00000
Value Added, Construction, Sector		.06290	.22420	.20025	.14254	.15958	.10060	.09977	.11805	.20934	.54725	.07724	.26192	.11594
Capital-Output Ratio		.18337	.68337	.58382	.43576	.48555	.29405	.29469	.33634	.63251	2.22868	.49017	1.03397	.48036

The capital unit coefficients are presented in Table 5. For this analysis, a unit of output is defined in dollars, thus each coefficient indicates the dollar amount of capital goods needed from the producing sector per dollar increase in output of the purchasing sector. For example, consider sector 6 (the textile mill products sector). For each dollar of output at capacity the sector needs .00017 dollars worth of capital goods from sectors 1 and 2 (the agricultural sector), .00184 dollars worth of capital goods from the mining sector, etc.

This matrix is useful when considering the amount of capital needed to increase output in a particular sector. Output can be increased in a sector without additional capital as long as the sector is not operating at capacity. If a sector is being operated at capacity and output needs to be expanded in that sector, capital per unit of output will be required according to the capital-output ratio. Composition of the required capital is determined from the capital unit matrix.

Capacity Estimates

Capacity estimates are difficult to measure and all present studies have inherent weaknesses. But until other methods are developed, present studies will have to be used. At least five different research groups measure industrial capacity at the national level. These groups include McGraw-Hill Department of Economics, the National Industrial Conference Board, *Fortune* magazine, the Wharton School Econometrics Unit, and the Division of Research and Statistics, Federal Reserve System.

The McGarw-Hill Department of Economics estimates are based on their Annual Survey of Business Plans for New Plants and Equipment. Firms are aggregated into fifteen major industrial classifications. No effort has been made by McGraw-Hill to define capacity in the survey and the individual companies are aggregated to industry levels through the use of employment weights [10]. The capacity estimates of the National Industrial Conference Board are obtained from fixed capital data as reported on the balance sheet of corporate income tax returns and published in *Statistics of Income* [39]. Needless to say, the estimation of constant dollar book value is an enormous task.

Very little can be said about the capacity estimates of *Fortune* magazine because of the lack of information describing how the estimates are derived and because of the admitted use of subjective judgment in the determination of data [10]. The Division of Research and Statistics of the Federal Reserve Board has two measures of capacity. One is the monthly output and annual capacity series. The other is a capacity measure based on a combination of the Index of Production, McGraw-Hill capacity data and the Department of Commerce estimate of con-

stant dollar fixed capital stock. Both measures are aggregate economy capacity estimates and of little value for this analysis.

The most recent capacity measure is the Wharton School capacity measure [16]. The procedure is extremely simple, but yet is considered as reliable as the other estimates [17]. The Federal Reserve Board Indexes of Industrial Production are averaged into quarterly figures. These are charted and peaks are determined by inspection. The 100 percent capacity level of operation is assumed at each peak and a straight line connecting the peaks describes capacity during periods between peaks. For any period which the latest peak has not been reached, a straight line is extrapolated from the last peak period until production intersects that line. After such an intersection, capacity is assumed equal to the line connecting the last peak and the most recent production figure.

A similar method was used to derive capacity levels for the 27 sectors in Oklahoma. However employment data were used as proxies for the production indexes. Although employment data are not as good an indicator as the production index, it is the best statistic available at the state level. The capacity estimates for Oklahoma's 27 sectors are presented in Table 6. These indicate the estimated level of operation of each sector. For example, sector 7 (the apparel and related products sector) is estimated to be operating at 91.44 percent of capacity. With

Table 6. Capacity Levels by Major Industry Group for Oklahoma, 1963.

	Sector	Capacity Level
1.	Livestock and Livestock Products	95.77
2.	Crops	95.77
3.	Mining	92.69
4.	Construction	95.32
5.	Food and Kindred Products	95.07
6.	Textile Mill Products	67.25
7.	Apparel and Related Products	91.44
8.	Lumber and Wood Products	90.80
9.	Furniture and Fixtures	72.43
10.	Paper and Allied Products	96.55
11.	Printing and Publishing	94.74
12.	Chemicals and Allied Products	90.60
13.	Petroleum and Coal Products	94.58
14.	Rubber and Plastics Products	89.69
15.	Leather and Leather Products	77.83
16.	Stone, Clay, and Glass Products	96.81
17.	Primary Metal Industries	93.24
18.	Fabricated Metal Products	86.34
19.	Machinery, Except Electrical	95.21
20.	Electrical Machinery	93.24
21.	Transportation Equipment	58.90
22.	Instruments and Related Products	85.71
23.	Miscellaneous Manufacturing	89.52
24.	Transportation, Communication, and Public Utilities	95.87
25.	Wholesale and Retail Trade	94.45
26.	Finance, Insurance, and Real Estate	98.18
27.	Services	93.74

Table 7. Capital Stock Matrix by Major Industry Group for Oklahoma, 1963. (Thousands of Dollars)

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agricultural Sectors	1+2	318,459	---	--	---	52	87	4	8	4	6	14	18	297	21
Mining	3	301	472	107	489	573	943	39	79	39	69	151	184	2,734	218
Textile Mill Products	6	---	---	---	---	27	48	2	5	2	4	8	9	154	11
Lumber and Wood Prod.	8	5,429	8,244	1,854	8,353	4,286	7,335	380	590	328	517	1,430	1,172	9,264	1,239
Furniture and Fixtures	9	94	239	6,675	498	242	220	16	19	12	17	75	38	391	46
Paper and Allied Prod.	10	759	1,182	279	1,227	173	319	10	11	10	19	51	28	178	53
Chemicals and Allied Prod.	12	410	644	150	667	702	1,017	43	87	40	74	220	209	2,698	224
Petroleum and Coal Prod.	13	1,304	2,043	471	2,114	810	1,388	64	108	62	103	247	249	2,959	321
Rubber and Plastics Prod.	14	94	161	557	71	34	55	2	5	2	4	12	9	148	13
Leather and Leather Prod.	15	182	161	---	2,423	---	---	---	---	---	---	---	---	---	---
Stone, Clay and Glass Prod.	16	15,336	24,004	5,603	24,868	9,222	14,255	635	1,139	606	1,050	2,900	2,617	34,825	3,089
Primary Metal Industries	17	4,655	7,283	1,704	7,543	5,283	8,007	329	749	313	572	1,600	1,805	32,026	1,826
Fabricated Metal Prod.	18	16,027	27,623	16,446	23,624	10,063	13,739	549	1,605	532	1,026	2,953	3,655	71,358	3,632
Machinery, Except Elect.	19	48,165	224,061	633,828	61,809	40,717	63,921	912	4,925	2,372	4,716	14,262	9,233	99,783	13,892
Electrical Machinery	20	2,639	4,952	20,646	4,328	3,988	5,530	2,061	528	406	493	1,079	1,404	20,105	1,693
Transportation Equipment	21	35,764	92,534	195,712	9,980	16,287	2,539	149	514	128	159	600	494	13,955	293
Instruments and Related Prod.	22	---	---	---	---	1,253	1,607	54	183	53	106	348	683	17,157	377
Miscellaneous Manufact.	23	364	483	---	142	144	220	8	18	9	16	48	40	581	50
Transportation, Communication, and Public Utility	24	2,369	9,326	23,356	1,996	2,149	3,274	142	280	133	241	684	627	9,311	736
Wholesale and Retail	25	20,069	77,984	146,781	10,766	---	---	---	---	---	---	---	---	---	---

Table 7. Cont'd.

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Finance, Insurance and Real Estate	26	---	---	---	---	5,653	8,588	374	742	349	633	1,792	1,644	24,440	1,932
Services	27	---	---	---	---	6,931	10,535	458	910	429	778	2,197	2,018	29,962	2,369
Value Added Construction Sector		47,106	73,732	17,228	76,390	48,406	74,668	3,272	6,535	3,037	5,410	15,424	14,574	220,739	16,586
Total		519,526	555,128	1,071,397	237,288	156,995	218,295	9,504	19,040	8,866	16,013	46,095	40,710	593,065	48,621

Sectors	Oklahoma Code	15	16	17	18	19	20	21	22	23	24	25	26	27
Agricultural Sectors	1+2	---	38	32	33	42	25	35	2	6	---	---	---	---
Mining	3	5	387	310	334	488	270	365	16	63	3,510	535	819	1,098
Textile Mill Products	6	---	22	17	18	24	14	20	1	3	1,229	1,919	946	1,212
Lumber and Wood Prod.	8	40	2,312	1,803	2,562	3,695	1,914	3,045	127	484	58,992	8,980	13,774	18,493
Furniture and Fixtures	9	2	104	65	107	143	86	96	5	19	20,387	32,624	22,197	28,802
Paper and Allied Prod.	10	2	69	23	37	96	54	60	4	17	8,830	1,341	2,059	2,766
Chemicals and Allied Prod.	12	5	504	367	400	563	269	388	17	75	4,784	726	1,118	1,497
Petroleum and Coal Prod.	13	7	530	374	456	734	406	520	25	98	15,201	2,311	3,546	4,762
Rubber and Plastics Prod.	14	---	27	20	20	28	14	20	1	4	291	3,838	116	364
Leather and Leather Prod.	15	---	---	---	---	---	---	---	---	---	---	---	---	364
Stone, Clay and Glass Prod.	16	17	5,902	4,452	4,849	7,260	3,998	5,325	253	1,063	178,674	27,195	41,712	56,007
Primary Metal Industries	17	43	3,794	2,982	2,789	3,788	2,086	2,873	135	527	54,208	8,249	12,656	16,996
Fabricated Metal Prod.	18	78	8,334	6,790	6,171	7,748	3,998	5,504	242	935	255,547	28,091	47,418	57,219
Machinery, Except Elect.	19	305	30,300	20,803	24,736	35,963	14,797	23,447	907	4,848	156,745	103,294	80,981	77,652
Electrical Machinery	20	53	3,222	2,410	3,064	4,169	3,828	2,786	115	614	411,623	17,849	11,538	40,323
Transportation Equip.	21	15	2,999	316	2,453	1,771	362	886	18	300	313,669	115,709	76,732	137,309
Instruments and Related Prod.	22	8	812	718	421	512	538	486	134	76	---	---	---	---
Miscellaneous Manufact.	23	1	106	76	81	116	58	80	4	16	805	10,613	470	17,738
Transportation, Communication, and Public Utility	24	17	1,527	1,140	1,255	1,758	898	1,245	55	240	93,975	8,127	5,195	8,626
Wholesale and Retail	25	---	---	---	---	---	---	---	---	---	108,013	75,181	56,427	69,632
Finance, Insurance and Real Estate	26	46	4,010	2,998	3,296	4,618	2,356	3,263	145	627	---	---	---	---
Services	27	57	4,915	3,672	4,040	5,665	2,889	4,001	179	769	---	---	---	---
Value Added Construction Sector		404	34,137	25,772	27,769	38,766	20,207	27,842	1,291	5,335	548,897	83,536	128,141	172,065
Total		1,165	104,051	75,140	84,891	117,947	59,067	82,287	3,676	16,119	2,235,380	530,118	505,845	712,925

capacity estimates, capital-output ratios, and the capital coefficient matrix, a capital stock matrix can be estimated.

Capital Stock Matrix

The capital-output ratio (defined as capital to output at capacity) times the estimated output at capacity yields the amount of capital in each sector. The amount of capital in a sector times that sector's capital coefficients column from the capital coefficient matrix yields the composition of each sectors' capital. The capital stock matrix for the 27 sectors in the Oklahoma model are presented in Table 7. Each element (K_{ij}) represents the total value of capital goods produced by sector i and invested in sector j. For example, consider sector 8 (the lumber and wood products sector). Total investment in the sector for 1963 is $19,040,000 of which $8,000 is from sector 1 and 2 (agricultural capital goods), $79,000 is from sector 3 (mining capital goods), etc.

Inventory Coefficients

Inventories consist of two types: (1) raw materials and goods in process, and (2) finished goods. Data to derive estimates on the state level are, in general, unavailable and hence national inventory coefficients were adopted in many cases. Use of national coefficients assumes that the inventory level per unit of output in Oklahoma is the same as in the nation as a whole. The inventory coefficients are presented in Table 8 and indicate the amount of inventory needed per unit of output. Techniques used to derive the coefficients and the data sources will be discussed in three subheadings which are the agricultural sectors, manufacturing sectors, and the remaining sectors.

Agricultural Sectors

For sector 1 (the livestock sector), finished goods were assumed to be the total value of cattle, sheep, and hogs on farms. The estimate of total value of livestock on farms was obtained by taking the average of the value of cattle, sheep and hogs on farms on January 1, 1963, and January 1, 1964 [25]. An adjustment was made to remove the value of livestock included as capital stock. The amount of raw materials and goods in process was assumed equal to one month's production. For sector 2 (the crop sector), the amount of finished goods as inventory was obtained by taking the average of the value of stocks of grain on farms on January 1, April 1, June 1, and October 1 [24]. Inventory of raw materials and goods in process was assumed equal to one month's production.

Table 8. Inventory Coefficients by Major Industry Group for Oklahoma, 1963

	Sector	Inventory Coefficient
1.	Livestock and Livestock Products	.556153
2.	Crops	.455087
3.	Mining	.066821
4.	Construction	.050028
5.	Food and Kindred Products	.096812
6.	Textile Mill Products	.161903
7.	Apparel and Related Products	.122734
8.	Lumber and Wood Products	.146135
9.	Furniture and Fixtures	.137331
10.	Paper and Allied Products	.105425
11.	Printing and Publishing	.077495
12.	Chemicals and Allied Products	.118312
13.	Petroleum and Coal Products	.101158
14.	Rubber and Plastics Products	.128705
15.	Leather and Leather Products	.132863
16.	Stone, Clay, and Glass Products	.121499
17.	Primary Metal Industries	.169358
18.	Fabricated Metal Products	.167442
19.	Machinery, Except Electrical	.219640
20.	Electrical Machinery	.173516
21.	Transportation Equipment	.122748
22.	Instruments and Related Products	.187690
23.	Miscellaneous Manufacturing	.168284
24.	Transportation, Communication and Public Utilities	.040943
25.	Wholesale and Retail Trade	.366129
26.	Finance, Insurance, and Real Estate	.005525
27.	Services	.027519

Manufacturing Sectors

The census of manufacturers [33 and 34] provided national inventories of raw materials and goods in process and of finished goods for the end of 1962 and 1963. The average was assumed the inventory level for 1963. The amount of domestic production was the value of shipments plus the change in finished goods inventory. Value of inventories divided by domestic production yielded the inventory coefficient.

Remaining Sectors[6]

The inventory coefficients of the remaining sectors were obtained from Internal Revenue data [38] and from the 1963 U.S. input-output table [35]. Internal Revenue data presented the amount of inventory for each of the remaining sectors. The Internal Revenue Service definition of inventory was similar to that used in this analysis. Value of output for these sectors was also obtained from the Internal Revenue Service [38], except for the wholesale and retail sector which was obtained from the national input-output table [35]. The inventory and output estimates

[6] Remaining sectors include mining; construction; transportation, communication, and public utilities, finance, real estate, and insurance; wholesale and retail trade; and services.

Table 9. Investment Matrix, for Major Industry Group for Oklahoma, 1963

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Agricultural Sectors	1+2	.72842	.25807	.00000	.00000	.00025	.00029	.00020	.00034	.00030	.00033	.00026	.00037	.00045	.00033
Mining	3	.00041	.00063	.06546	.00163	.00276	.00313	.00205	.00325	.00319	.00361	.00282	.00383	.00412	.00352
Construction	4	.00000	.00000	.00000	.21416	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Food and Kindred Products	5	.00000	.00000	.00000	.00000	.24299	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Textile Mill Products	6	.00000	.00000	.00012	.00019	.00016	.00019	.00000	.00000	.00012	.27554	.00016	.00019	.00023	.00018
Apparel and Related Prod.	7	.00000	.00000	.00000	.00000	.00000	.00000	.50233	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Lumber and Wood Prod.	8	.00733	.01102	.00162	.02765	.02066	.02434	.01989	.23945	.02679	.02687	.02680	.02447	.01396	.02001
Furniture and Fixtures	9	.00012	.00032	.00582	.00167	.00115	.00073	.00086	.00078	.27825	.00088	.00144	.00079	.00059	.00075
Paper and Allied Prod.	10	.00103	.00158	.00024	.00407	.00083	.00105	.00053	.00044	.00079	.16871	.00095	.00060	.00027	.00085
Printing and Publishing	11	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.13656	.00000	.00000	.00000
Chemicals and Allied Prod.	12	.00055	.00086	.00013	.00222	.00339	.00339	.00225	.00359	.00329	.00385	.00412	.15454	.00407	.00361
Petroleum and Coal Prod.	13	.00177	.00273	.00041	.00698	.00391	.00461	.00332	.00443	.00505	.00533	.00462	.00519	.11081	.00520
Rubber and Plastics Prod.	14	.00012	.00021	.00049	.00021	.00017	.00019	.00012	.00019	.00016	.00021	.00023	.00019	.00022	.21521
Leather and Leather Prod.	15	.00025	.00022	.00000	.00800	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Stone, Clay and Glass Prod.	16	.02071	.03208	.00489	.08236	.04445	.04732	.03328	.04696	.04936	.05456	.05433	.05463	.05247	.04988
Primary Metal Industries	17	.00629	.00974	.00149	.02500	.02548	.02659	.01723	.03087	.02548	.02970	.02996	.03767	.04826	.02948
Fabricated Metal Prod.	18	.02165	.03692	.01434	.07825	.04852	.04560	.02877	.06618	.04334	.05330	.05531	.07630	.10752	.05863
Machinery Except Elect.	19	.06506	.29946	.55292	.20470	.19633	.21218	.04777	.20304	.19340	.24513	.26716	.19274	.15035	.22428
Electrical Machinery	20	.00356	.00662	.01801	.01434	.01923	.01835	.10789	.02177	.03313	.02563	.02021	.02931	.03030	.02733
Transportation Equipment	21	.04830	.12367	.17073	.03305	.07854	.00842	.00778	.02120	.01044	.00829	.01124	.01031	.02103	.00473
Instruments and Related Prod.	22	.00000	.00000	.00000	.00000	.00605	.00534	.00282	.00755	.00432	.00552	.00652	.01427	.02584	.00608
Miscellaneous Manufact.	23	.00049	.00065	.00000	.00047	.00070	.00073	.00041	.00077	.00071	.00084	.00090	.00083	.00087	.00080
Transportation, Communication, and Public Utility	24	.00320	.01246	.02038	.00659	.01037	.01087	.00749	.01153	.01084	.01257	.01281	.01308	.01403	.01189

Table 9. Cont'd.

Sectors	Oklahoma Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Wholesale and Retail	25	.02711	.10422	.12804	.03566	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Finance, Insurance and Real Estate	26	.00000	.00000	.00000	.00000	.02726	.02851	.01957	.03056	.02848	.03294	.03359	.03432	.03683	.03121
Services	27	.00000	.00000	.00000	.00000	.03341	.03497	.02399	.03751	.03490	.04040	.04115	.04215	.04515	.03834
Value Added Construction Sector		.06363	.09854	.01503	.25299	.23343	.24785	.17133	.26940	.24762	.28114	.28886	.30422	.33263	.26779
Total		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Sectors	Oklahoma Code	15	16	17	18	19	20	21	22	23	24	25	26	27
Agricultural Sectors	1+2	.00025	00031	.00033	.00028	.00024	.00026	.00031	.00027	.00029	.00000	.00000	.00000	.00000
Mining	3	.00240	.00316	.00320	.00285	.00285	.00287	.00314	.00277	.00306	.00154	.00058	.00162	.00146
Construction	4	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Food and Kindred Prod.	5	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Textile Mill Prods.	6	.00013	.00017	.00017	.00015	.00014	.00015	.00017	.00013	.00016	.00054	.00207	.00186	.00161
Apparel and Related Prod.	7	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Lumber and Wood Prod.	8	.01391	.01886	.01860	.02180	.02157	.02038	.02614	.02225	.02374	.02591	.00969	.02709	.02453
Furniture and Fixtures	9	.00051	.00085	.00068	.00091	.00084	.00092	.00081	.00092	.00094	.00896	.03522	.04365	.03822
Paper and Allied Prod.	10	.00019	.00056	.00024	.00032	.00055	.00058	.00050	.00067	.00082	.00388	.00145	.00405	.00366
Printing and Publishing	11	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Chem. and Allied Prod.	12	.00281	.00414	.00378	.00340	.00329	.00287	.00333	.00292	.00367	.00210	.00078	.00220	.00199
Petroleum and Coal Prod.	13	.00288	.00432	.00386	.00388	.00428	.00432	.00446	.00439	.00481	.00668	.00250	.00697	.00632
Rubber and Plastics Prod.	14	.00016	.00022	.00021	.00017	.00017	.00015	.00017	.00015	.00020	.00013	.00415	.00023	.00047
Leather and Leather Prod.	15	.42014	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00047
Stone, Clay and Glass Prod.	16	.03434	.19911	.04593	.04126	.04237	.04256	.04568	.04420	.05211	.07849	.02937	.08202	.07431
Primary Metal Indus.	17	.02302	.03096	.25562	.02372	.02212	.02222	.02465	.02362	.02581	.02381	.00891	.02489	.02254
Fabricated Metal Prod.	18	.05240	.06801	.07004	.33011	.04524	.04256	.04722	.04217	.04583	.11226	.03033	.09324	.07590
Machinery, Except Elect.	19	.16052	.24724	.21460	.21051	.52141	.15754	.20115	.15831	.23755	.06885	.11154	.15924	.10302
Electrical Machinery	20	.01859	.02629	.02486	.02608	.02433	.41187	.02391	.02007	.03008	.18082	.01927	.02268	.05350
Transportation Equip.	21	.00243	.02446	.00327	.02087	.01034	.00385	.30165	.00315	.01471	.13779	.12494	.15088	.18217
Instruments and Related Prod.	22	.00553	.00662	.00741	.00358	.00299	.0573	.00417	.38152	.00373	.00000	.00000	.00000	.00000
Miscellaneous Manufact.	23	.00057	.00087	.00078	.00070	.00068	.00062	.00067	.00063	.21094	.00035	.01146	.00092	.02353
Transportation, Communication, and Public Util.	24	.00882	.01248	.01175	.01068	.01027	.00956	.01054	.00975	.01173	.05932	.00878	.01022	.01144
Wholesale and Retail	25	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
Finance, Insurance and Real Estate	26	.02312	.03273	.03092	.02805	.02696	.02509	.02800	.02551	.03072				
Services	27	.02837	.04011	.03788	.03438	.03307	.03075	.03433	.03133	.03768	.00000	.00000	.00000	.05419
Value Added Construction Sector		.19891	.27856	.26587	.23630	.22629	.21515	.23900	.22527	.26142	.24112	.09020	.25197	.22828
Total		1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

were then used to derive the inventory coefficients for the remaining sectors.

Investment Matrix

Some researchers desire to know the total amount of capital needed to expand output as well as its composition. By adding the capital unit coefficients and the inventory coefficients for a sector, the total amount of capital required per unit of output expansion is estimated. This addition would yield a combined capital and inventory unit coefficient matrix from which an investment matrix is calculated. Each coefficient (I_{ij}) in the investment matrix is obtained by dividing the column entry of the combined capital and inventory unit matrix by the total of all entries for that column. Investment coefficients are defined as the value of output of the producing sector i needed by the purchasing sector j per unit of investment in j. The investment matrix is presented in Table 9. (See page 22 and 23)

Sector 9 (the furniture and fixture sector) shows that for each dollar of investment in that sector, .00030 dollars worth of capital goods are required from sectors 1 and 2, .00219 dollars worth of capital goods are required from sector 3, .27825 dollars worth of goods which includes investment of its own capital products and the necessary inventory from sector 9, .00079 dollars worth of capital goods from sector 10, etc. The difference between the investment coefficients and the capital coefficients is that the investment coefficients include capital and inventory expenses per unit of investment, while the capital coefficients include only the capital requirements per dollar of capital investment in a sector.

Output-Labor Ratios

To analyze the relationship between labor and output, the output-labor ratios were developed. The output-labor ratios indicate the amount of output produced per man-year of employment. The ratios can be used to determine the labor intensiveness of each sector. The sector having large output-labor ratios can be classified as capital intensive, whereas the sectors having small output-labor ratios are labor intensive.

Presented in Table 10 are the output-labor ratios for the 27 sectors. Output was defined as the value of receipts, except for the wholesale and retail trade sector where output was defined as the value of receipts minus the cost of goods sold. Output data were obtained from the Census of Manufacturing for the manufacturing sectors and from various other

Table 10. Output-Labor Ratios by Major Industry Group for Oklahoma, 1963

	Sector	Output-Labor Ratio
1.	Livestock and Livestock Products	$ 5,482
2.	Crops	5,482
3.	Mining	21,556
4.	Construction	24,056
5.	Food and Kindred Products	34,820
6.	Textile Mill Products	17,427
7.	Apparel and Related Products	15,279
8.	Lumber and Wood Products	16,129
9.	Furniture and Fixtures	15,720
10.	Paper and Allied Products	35,025
11.	Printing and Publishing	15,032
12.	Chemicals and Allied Products	43,275
13.	Petroleum and Coal Products	118,709
14.	Rubber and Plastics Products	37,679
15.	Leather and Leather Products	12,916
16.	Stone, Clay, and Glass Products	21,495
17.	Primary Metal Industries	31,659
18.	Fabricated Metal Products	21,477
19.	Machinery, Except Electrical	20,967
20.	Electrical Machinery	19,797
21.	Transportation Equipment	21,269
22.	Instruments and Related Products	16,909
23.	Miscellaneous Manufacturing	21,015
24.	Transportation, Communication, and Public Utilities	18,832
25.	Wholesale and Retail Trade	7,747
26.	Finance, Insurance, and Real Estate	10,566
27.	Services	8,507

sources for the remaining sectors.[7] Labor data were obtained from the Census of Manufacturing [33 and 34] for the manufacturing sectors and from the U.S. Internal Revenue Service and U.S. Department of Labor.[8]

The petroleum and coal products sector has the largest output-labor ratio at $118,709. Next in order of magnitude, were the chemical and allied products and rubber and plastic products sectors with output-labor ratios of $43,275 and $37,679 respectively. The sectors having the smallest output-labor ratios were the livestock and livestock products, crops, services, and wholesale and retail sectors.

Depreciation Coefficients

To complete the capital structure analysis, depreciation coefficients were estimated. Depreciation rates were estimated as the ratio of de-

[7] For sources and definitions of sector output see Docksen, Ibid.

[8] Wage and salary employment were obtained from the U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for States and Areas 1939-1968. Washington: Government Printing Office, 1969. Proprietor employment data were estimated from U. S. Internal Revenue Service, *Statistics of Income, 1963* U. S. Business Tax Return, U. S. Treasury Department Publication No. 438 (4-67).

preciation to depreciable assets. The amount of annual depreciation and depreciable assets were obtained from U.S. Internal Revenue Service, U.S. Business Tax Return [38]. Depreciation rates adopted for the Oklahoma capital analysis are presented in Table 11. These coefficients indicate that the annual depreciation rates for the various sectors range from 4% to 10% of total depreciable assets.

Summary and Uses

The major purpose of this study was the presentation and quantification of the capital structure for Oklahoma. The main value of the study is to provide capital data to researchers for later investigations. The following matrixes were derived and are useful for further empirical studies:

1) a capital coefficient matrix—which indicates the amount of capital needed from the i^{th} sector per dollars worth of capital investment in the j^{th} producing sector;

Table 11. Depreciation Rates by Major Industry Group for Oklahoma, 1963.

	Sector	Depreciation Rate
1.	Livestock and Livestock Products	.072086
2.	Crops	.098516
3.	Mining	.067066
4.	Construction	.104708
5.	Food and Kindred Products	.071142
6.	Textile Mill Products	.069865
7.	Apparel and Related Products	.084806
8.	Lumber and Wood Products	.069240
9.	Furniture and Fixtures	.073477
10.	Paper and Allied Products	.063894
11.	Printing and Publishing	.073557
12.	Chemicals and Allied Products	.077493
13.	Petroleum and Coal Products	.043179
14.	Rubber and Plastic Products	.078285
15.	Leather and Leather Products	.079409
16.	Stone, Clay, and Glass Products	.065940
17.	Primary Metal Products	.054598
18.	Fabricated Metal Products	.075931
19.	Machinery, Except Electrical	.084133
20.	Electrical Machinery	.088414
21.	Transportation Equipment	.073944
22.	Instruments and Related Products	.095127
23.	Miscellaneous Manufacturing	.075734
24.	Transportation, Communication, and Public Utilities	.041202
25.	Wholesale and Retail	.083568
26.	Finance, Insurance, and Real Estate	.047404
27.	Services	.108985

2) a capital stock matrix—which indicates the amount of capital from the i^{th} sector needed to produce the output of sector j,
3) a capital unit matrix—which indicates the amount of capital from the i^{th} sector needed per unit of output of the j^{th} producing sector; and
4) an investment matrix—which indicates the capital and inventory requirements from the i^{th} sector per unit of output of the j^{th} producing sector.

Other estimates computed in the Oklahoma capital analysis were inventory coefficients, depreciation coefficients, and capacity levels for each sector.

The capital data can be used in comprehensive models to evaluate alternative development strategies. Some illustrations of comprehensive models requiring capital data are listed below.

1) The dynamic input-output model. Many researchers are disenchanted with the static conditions associated with the input-output model and desire to incorporate the effects of investment, thus moving towards the application of a dynamic input-output model. Capital data as supplied by this analysis are needed for a dynamic input-output model. A reference which used this technique is by Bargur [2].
2) Simulation models. Models which simulate a region's economy need to include the effects of investment and depreciation. Again a capital account provides the necessary data. Maki [22] applies a simulation model to the economy of Iowa.
3) Activity analysis. This regional tool also requires capital data and Spiegelman's model [28] offers an illustration of the capital needs in an activity analysis framework.

In summary, the usefulness of the Oklahoma capital analysis can be classified into three parts. (1) The analysis provides valuable methodology and documentation to fellow regional economists who need capital data for their models. (2) The analysis provides capital data for state planning models for Oklahoma. (3) The analysis provides capital data on individual sectors which will be very useful in sector analysis.

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