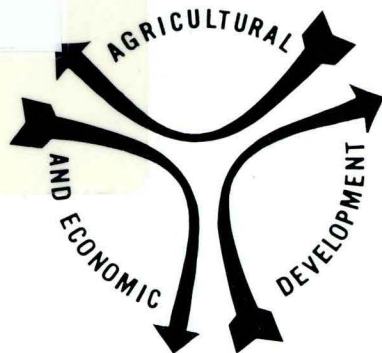


S
61
.R47
No.530
1964



Regional Intersectoral Relations and Demand Projections With Emphasis on the Feed-Livestock Economy of the North Central States

by Wilbur R. Maki and Dean F. Schreiner

Department of Economics and Sociology

Center for Agricultural and Economic Development

**AGRICULTURAL AND HOME ECONOMICS EXPERIMENT STATION
IOWA STATE UNIVERSITY of Science and Technology**

IOWA STATE TRAVELING LIBRARY
DES MOINES, IOWA

RESEARCH BULLETIN 530

DECEMBER 1964

AMES, IOWA

IOWA STATE TRAVELING LIBRARY
DES MOINES, IOWA

CONTENTS

Summary	206
Introduction	209
Economic information for decision-making in the feed-livestock economy...	209
Problems in generating basic data for long-range planning.....	212
Economic model	212
Functional relationships	212
Leontief system of interindustry transactions.....	214
Regional differentiation of technical structure.....	215
Temporal differentiation of technical structure.....	217
Data sources and requirements	217
Intersectoral transactions table	217
Final demand and primary input sectors	218
Regional and interregional models	220
Data manipulation	220
Projected demands for agricultural products	222
Analytical procedures	222
Aggregate demand and output estimates	223
Regional production equations	224
Regional demand estimates	226
Estimation of intersectoral transactions	229
Constructing the flow matrices	229
The direct requirements matrix	234
Market disbursement matrix	234
The inverse matrices: direct and indirect requirements	235
Use of data in prediction and analysis	235
Evaluating investment prospects in agriculture and related sectors	258
Literature cited	263

SUMMARY

This study deals with the agricultural economy of the North Central States and the transactions that occur among the various sectors and related manufacturing and service businesses in the region. The analytical framework—the intersectoral transactions table—provides a means of organizing a vast amount of data pertaining to the North Central Region. In addition, the data that have been prepared can be used in evaluating major areas of investment opportunities in agriculture and agriculturally related business in the region.

The evaluation of investment opportunities in this study starts with projections of manufacturing and other final demands for the agricultural products of the North Central Region and its subregions. According to the detail-

ed estimates of demand for agricultural products outside of agriculture, for example, the North Central Region would fulfill more than 2.4 billion dollars of the 4.2 billion dollars expected increase (in constant 1955 dollars) in the demand for meat animals over the 20-year period from 1955 to 1975. A substantial part of the total increase in demand—about 1 billion dollars—would be for the meat-animals output of the Western Corn Belt; namely, Iowa, Minnesota and Missouri. The Northern Plains—North Dakota, South Dakota, Nebraska and Kansas—would account for 745 million dollars of the total regional demand, while the five states in the East North Central Region—Illinois, Wisconsin, Indiana, Ohio and Michigan—would account for the remaining 700 million dollars of the total. Thus, 41 percent of the total increase in the demand for the meat-animals output of north central agriculture would be concentrated in the Western Corn Belt, according to the findings of this study.

Demand expansion for the meat-animals sector of north central agriculture would have important repercussions for all other agricultural sectors in the region. Many of these repercussions cannot be ascertained directly because the expected demand increases for these sectors would result from the production increases in the meat-animals sector. Hence, an intersectoral transactions table has been prepared to estimate the indirect or derived demands for agricultural production that occur because of the production interdependencies among the different agricultural sectors (e.g., the interdependence between meat-animals production and feed-grain production).

Another important segment of north central agriculture is the farm-dairy-products sector. This study shows, however, that the North Central Region will fulfill only 683 million dollars of the total 2-billion-dollar expected increase in demand for farm dairy products in the United States over the 1955-75 period. A major part of the expected increase in demand for the regional output—439 million dollars—would be concentrated in the five East North Central States. Thus, a further tendency for agricultural specialization within the North Central Region is suggested by the demand projections. Again, however, the expected increase in the demand for livestock products would have important repercussions in the derived demands for feed crops and forage. The geographical location of the feed and forage thus would be affected in a rather complex way by the differential regional rates of expansion in their derived demands and by transformation of the feed and forage into meat, dairy products and other outputs of livestock agriculture.

To illustrate the nature of the production interdependencies in the agriculture of the North Central Region and its subregions, an input-output table is presented as a major contribution of this study. Exactly the same 18-sector breakdown of agriculture is used in this regional study as was used in a study of intersectoral transactions in United States agriculture that was completed recently by the United States Department of Agriculture.

In this study, the inputs and outputs of each of the 18 agricultural sectors were estimated for each of the three subregions and for the North Central Region as a whole. The input-output analysis covers the 1955 calendar year, which also is the base year for the 20-year demand projections included in the study.

The input-output table and the analysis of flows between agricultural and nonagricultural sectors for the base year illustrate the structure of north central agriculture. A series of input-output coefficients also are presented as a source of information on the specific input structure of the regionally differentiated agriculture. In the North Central States, for example, the meat-animals sector requires inputs from the agricultural segment, composed of 18 sectors; from the industrial segment, composed of 15 manufacturing sectors and 9 services sectors; and from primary factors, composed of 7 sectors. The major input of the meat-animals sector is from the feed-crops sector and amounts to \$404,771,000 of output. The total inputs from manufacturing and services sectors are \$152,817 per million dollars of output. Likewise, primary inputs totaled \$224,066 per million dollars of output.

The market structure of agriculture is illustrated by the table of market disbursements which shows the market destination of the output of each agricultural sector. Agricultural products are sold to other agricultural sectors, to intermediate processing industries (composed of nine manufacturing sectors and four services sectors) and to a final-use sector. Since this study was concerned with potential market outlets, market disbursements were not defined on a regional basis, but aggregate or national coefficients were used to determine the potential regional processing for any given level of regional production. It is possible, therefore, to trace the complete structure of the meat industry from the primary resources necessary for its agricultural production to the processing of the commodities for final use. The interaction between the meat industry and supporting industries also can be traced.

By assuming constant coefficients of production and linearity of the production functions, the agricultural segment of the economy can be formed into a closed system where direct and indirect input requirements are obtained for any sector. These requirements are used in the sales of goods to the intermediate processing and final-demand sectors. The interdependence coefficients derived for the meat-animals sector of the North Central Region, for example, show that, to deliver \$1,000,000 of output to the intermediate processors and final-use sectors, the gross output of the meat-animals sector must be \$1,256,422, and the output of the feed-crops sector must be \$526,654. The multiplier effect from a million-dollar increase in intermediate and final demand of the meat-animals sector is equal to the column sum of the interdependence coefficients matrix, or \$1,818,067.

By projecting intermediate processor and final use for the agricultural sectors to 1975 and by applying regional allocation rules to these projections, direct and indirect requirements were computed for each region and sector in terms of constant 1955 dollars. From these projected requirements, industrial needs, primary resource needs and potential market outlets were generated.

Related data on livestock marketing adjustments covering the 1955-65 period show the components of the meat-animals sector in substantially greater detail. The detailed data are essential for studies of industrial location. The latter studies, however, deal with partial economic systems. Because of the more comprehensive agricultural input-output study, the partial economic analyses of industrial location and interregional competition can be tied together systematically, and their aggregate implications can be evaluated with reference to a regional economy as a whole. It is in this context that the input-output study of north central agriculture may serve its most useful purpose as a source of basic data for future studies of area economic systems and for investment planning.

The regional models described and fitted in this study are intended to give a broad aggregative view of the input and market structure for north central agriculture. Although much of the data were gathered and computed on a commodity basis, detailed input-output tables were not derived because of the lack of essential data, particularly on the input side. Hence, the aggregation problem has masked some of the differential effects of changing consumer preferences, especially in the meat-animals sector. This problem is not as limiting as might be expected, because of similarity of inputs and market outlets. Nonetheless, for detailed information concerning individual commodities within any one sector, the present study should be extended.

Further studies may quite profitably explore in greater detail the structure of industries closely related to agriculture and include these industries within the interacting matrix. In this way, the total interdependence of agriculture and related industries could be measured. On the national level, this could be done by using presently available interindustry coefficients and by revising them according to other sources of information. Interregional trading patterns also could be computed for the North Central Region and the rest of the United States. Finally, the regional interindustry relations for 1955 and the regional demand projections for 1975 provide useful data for industrial-complex analyses and studies of interregional competition in agriculture.

Regional Intersectoral Relations and Demand Projections With Emphasis on the Feed-Livestock Economy of the North Central States¹

by Wilbur R. Maki and Dean F. Schreiner

The feed-livestock complex of the North Central Region produces enough beef, pork, lamb and mutton to meet the consumption needs of more than 100 million people—nearly 60 percent of the total national population. Over 30 billion pounds of meat animals are produced by farmers in the 12 states of the North Central Region.²

The concentration of meat-animal production in the North Central Region can be attributed to a corresponding concentration in feed-grain supplies and in technological and managerial capabilities as well as to growth in aggregate demand for meat products. Indeed, the conversion of feed into meat animals has taken on the characteristics of an assembly line production. Nonetheless, according to Allin, "The feed-grain livestock problems will continue to be the most difficult problems to solve and will attract relatively more public attention" (1).

In providing adequate information for production and investment planning in the feed-livestock economy, much more than the production or marketing segments of this complex becomes involved in the data collection and analysis. The location and organization of meat packing and related activities, for example, are influenced by the location and organization of livestock production. Thus, the livestock-producing sector becomes a focus of interest with reference to investment decisions in livestock marketing, transportation and processing facilities. In addition, changing consumption patterns and transportation-rate relationships influence investment decisions of meat packers because of the substantial weight loss in processing and the related transportation economies. Finally, marketing decisions are, at least partly, consumer-oriented insofar as geographical differences in consumer preferences favor small, specialized meat-processing facilities catering to local or metropolitan markets.

When the interdependencies in the livestock sector are examined more closely, meat processing is recog-

nized as only one of several activities involved in the feed-livestock complex. The leather industry, for example, derives its principal raw materials from the meat-packing industry just as do segments of the fats and oils and the pharmaceutical industries. Finally, the meat-products sector of agriculture derives inputs from the feed-grains sector which, in turn, derives its inputs from a variety of sources, including the meat-products sector. Thus, a vast network of interdependencies influences the meat-processing industry in terms of the direct effects originating from the meat-producing sector and the numerous indirect effects originating from the remaining agricultural input sectors.

Because of the importance of the meat-products sector of agriculture in the investment decisions of meat packing and related businesses, it is one focus of interest in this report. In addition, the inter-industry or intersectoral relations in agriculture are investigated insofar as they influence the meat-products sector and, thus, the meat-packing and marketing sectors. This report involves, therefore, a discussion of several agricultural sectors with reference to historical levels of production and projected changes in the demand for the products of these sectors, specifically the products originating in the North Central Region.

ECONOMIC INFORMATION FOR DECISION-MAKING IN THE FEED-LIVESTOCK ECONOMY

Sources of needed information on prospective changes in the marketing places of the feed-livestock economy can be obtained from north central regional research projects on adjustments in the marketing of livestock, dairy products and grain.³ In addition, the North Central Farm Management Research Committee has initiated a research study of the livestock-producing sector.⁴ Altogether, these studies deal with much of the feed-livestock complex in the North Central Region.

An important segment of this complex is located in Iowa. Iowa is a major area of feed-grain and livestock production, accounting for over 20 percent of

1/ Project No. 1460, Iowa Agricultural and Home Economics Experiment Station, Center for Agricultural and Economic Development cooperating. This study was undertaken as an extension of the Iowa contributing project to NCM-25—the north central regional project on "Adjustments in Livestock Marketing in the North Central States to Changing Patterns of Production and Consumption."

2/ The North Central Region includes the 12 North Central States—Kansas, Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin.

3/ The titles of these projects are: "Adjustments in Livestock Marketing to Changing Conditions of Production and Consumption," NCM-25; "Structural Changes in the Dairy Industry," NCM-26; and "Impact of Changing Conditions on Grain Marketing Institutions and the Structure of Grain Markets," NCM-28.

4/ "Feed Supply Responses—Hog and Pork," NC-54.

the nation's corn production and nearly 14 percent of its farm output of meat animals. Because of the dominant position of the feed-grain complex in Iowa's total economic activity, the production and marketing interrelationships, even in the Iowa economy, must be viewed from the standpoint of a variety of decision-makers — those in governmental administration as well as those in private business.

Data Requirements in the Marketing Sectors

Data needs in marketing livestock and feed grains are examined, first, to illustrate some informational bases for investment decisions. As pointed out by economists, decisions regarding capital expenditures and capital requirements invariably are based on future prospects.

Two approaches can be postulated: one, in which the future income stream of a business enterprise is estimated under different assumptions regarding the level or rate of investment; the other, in which long-range demand projections are used to confirm workable profit prospects based on recent levels of sales and relatively full use of capacity (3). Demand projections for each of 18 agricultural sectors of the North Central Region have been prepared, therefore, as a basis for confirming favorable and discouraging unfavorable investment prospects in the livestock and grain-marketing sectors of the region.

In addition to forecasting the market demands for the region's agricultural products, long-run trends in labor productivity in agricultural production will be used as part of a related study in converting the demand projections into estimates of future agricultural resources requirements. Thus, given the demand projections and the technical structure of north central agriculture, the gross output estimates can be converted into farm labor and capital requirements. For the marketing sectors, however, independently derived estimates of agricultural resources can be used to estimate the potential supply of agricultural outputs. If the potential supplies substantially exceed the projected demands, price and input adjustments can be expected.

Using Public Information

Estimates of future conditions involve elements of uncertainty; so do decisions that require choices among alternative courses of action. Because decision-makers are faced with the uncertainty of future outcomes, various methods of discounting uncertainty, of negotiating with the environment so as to reduce uncertainty and of adapting short-term plans to changing conditions have been developed.

To facilitate decision-making with reference to capital expenditures, a variety of public forecasts and projections on the agricultural sectors are prepared periodically by the United States Department of Agriculture. These estimates are offered as bases for making long-range business plans in the face of

uncertainty regarding the reaction of other business enterprises to changes in conditions.

Widely accepted public forecasts and projections can be self-confirming insofar as the related business decisions are made on the supposition that the forecast is in fact a goal or common business expectation. In this study, however, the demand and resource input projections are confined to the major agricultural commodities. An additional series of more specialized commodities forecasts are needed for long-range planning among individual businesses or governmental agencies. The estimates of prospective demands for broad categories of agricultural outputs provide a means of establishing consistency among a much larger number of specific commodity forecasts that are being used in long-range business planning.

Another means of achieving consistency in a series of demand and supply projections for agriculture is the intersectoral transactions table. The sales and purchases among the different agricultural and agriculturally-related sectors are illustrated, first, as a flow chart in fig. 1. The total purchases of the livestock sector, for example, which amount to more than 9.3 billion dollars, cover a wide range of industry sources. More than half of the total purchases — 5.4 billion dollars — originate from the agricultural sectors. Manufacturing industries contribute another billion dollars worth of inputs to the livestock sector. On the other hand, most of the sales are to the manufacturing sectors, primarily meat-packing and dairy-processing plants.

The 1955 data represented in fig. 1, along with certain assumptions about the prospective demands for agricultural products, can be converted into prospective demands for primary resource requirements and other agricultural inputs. Thus, given certain forecasts of consumption and exports, for example, a corresponding series of forecasts of agricultural outputs and inputs can be prepared for the United States and its major agricultural regions.

Since the demand projections and intersectoral relations presented in this report are intended for the use of economic and business analysts in more specialized studies of north central agriculture, the empirical results are viewed initially from a theoretical standpoint. Problems in generating basic data for long-range planning are examined in the context of relevant economic models for data generation, including the input-output model used in this study. Second, a series of national and regional estimates of prospective demands for specified groups of agricultural commodities are presented for later use in the report. Third, the estimation of intersectoral transactions is considered as an outgrowth of the theoretical examination of the Leontief input-output model. Fourth, some applications of the data in prediction and analysis are examined. Finally, the research results are applied to an evaluation of investment prospects in agriculture and related sectors in the North Central Region.

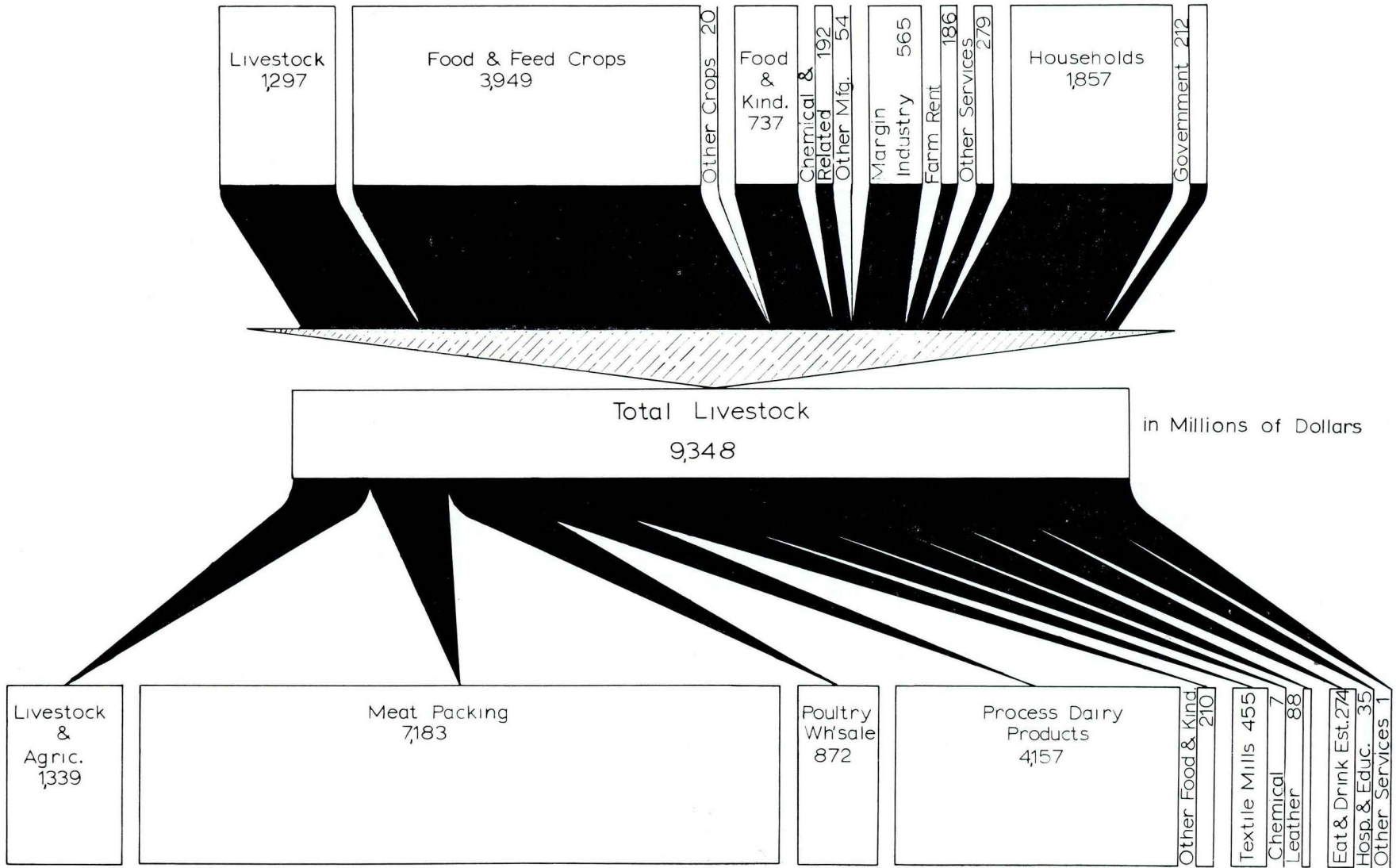


Fig. 1. Interindustry transactions and commodity flows, United States, 1955.

PROBLEMS IN GENERATING BASIC DATA FOR LONG-RANGE PLANNING

The demand and agricultural output projections for the feed-livestock complex are being prepared in several stages. With reference to the meat-animals sector, projections to 1975 are being prepared of livestock marketings and slaughter and of meat consumption on a 26-region basis. These projections will be reported in forthcoming publications of the North Central Livestock Marketing Research Committee. The livestock projections, moreover, are being organized in a meaningful way by use of a spatial equilibrium model of the regionally and functionally differentiated livestock-meat economy.

The implications of the linear programming results, obtained as part of the livestock marketing research, will be studied with reference to the organization and structure of the meat-packing and related industries. In this report, however, the basic sources of change in the meat-packing industry that emanate from the meat-products and related sectors in agriculture are examined closely and thoroughly insofar as they affect the interpretation of the data generated by the regional research in livestock marketing.

Problems in the preparation of the data reported in this study have been twofold. First, an adequate economic model of agricultural interdependencies was needed to organize the vast amounts of data dealing with the technical structure of agriculture. In addition, the regional and sectoral implications of projected levels of aggregate demand for specified agricultural products needed to be examined. Both of these problems were handled through the use of a Leontief-type input-output model of agriculture. With reference to projected levels of agricultural outputs, demand estimates for regional outputs were developed on the basis of historical relationships covering the post-World War II period.

A second problem in data preparation relates to the fitting of the economic model. This problem was more critical several years ago than it is now (see references 2, 18 and 20). An 18-sector study of United States agriculture for the 1955 calendar year was completed recently that has added considerable new data for developing more detailed regional inter-industry transaction tables of agriculture (17). In spite of the additional national input-output data and the abundance of state data on agricultural outputs and inputs, considerable judgment was involved in developing several series, because specific information on interregional and intersectoral commodity transfers was lacking. Each of the estimated series is discussed fully with reference to its derivation and apparent shortcomings.

Economic Model

In this section, the basic elements of input-output models are presented for later discussions of the re-

gional input-output approach and data manipulation associated with fitting the more specialized models. The basic elements include the production function, the consumer-demand function, market-price relationships and identities. The organization of these elements into analytical procedures for data analysis is also discussed in this section.

Functional relationships

Production function. The production function is one of the major components of basic input-output theory. In this study, the production function is used in an ex-ante or a planning framework. In essence, the production function shows the opportunities for substitution among the inputs contributing to output variability. It also shows the contribution of each input to output. For this reason, output is considered in a physical sense and an incremental sense. Input variables, for example, are represented in constant dollars; output is represented as a net additional contribution of the particular enterprise or economic sector.

Finally, the effects of technological change may be introduced by using an additional variable representing, essentially, the technological impact on output, given all other inputs. Thus, a linear production function could be represented by the form,

$$X'_{jt} = \alpha_j Z_{1t} + \beta_j Z_{2t} + \gamma_j t, \quad (1.1)$$

where X'_{jt} equals net additional output or value added, of sector j , t -th year.

Z_{1t} and Z_{2t} are primary factors of production or primary inputs. The constants α , β and γ represent the constraints on production imposed by the existing state of technology. The trend coefficient, γ_j , may be defined as the year-to-year increase in output as a result of technology.

Consumer demand function. The consumer demand equation is involved implicitly, if not explicitly, in the analyses that follow. In any case, it is used in the conventional sense as the relationship of the quantity consumed per capita with the average price of the given commodity and of a competing or complementary commodity and with consumer income. Again, the function may be expressed linearly, as shown by the form,

$$x_{it} = A_i + B_{i1}P_{it} + B_{i2}P_{jt} + C_i I_t, \quad (1.2)$$

where

x_{it} = the per-capita consumption of the i -th commodity, t -th year.

P_{it} = the average retail price of the i -th commodity, t -th year.

P_{jt} = the average retail price of a j -th competing or complementary commodity, t -th year.

I_t = the average per-capita income, t -th year.

The coefficients A_i , B_{i1} , B_{i2} and C_i are the constraints on per capita consumption.

Market price relations. Because of the structure of agricultural markets, wholesale rather than retail prices are most responsive to the broad, national, price-making forces, such as aggregate commodity supplies and consumer incomes (14). Over time, retail prices adjust to wholesale price changes as well as to changes in retailing costs. Primary, or local, market prices also respond to the price direction given by the better-organized central or wholesale markets. Thus, the wholesale price generates relevant market information for each major market level. The wholesale price, moreover, is a function of the major price determinants, as shown by the form,

$$p_{it}^w = a_i + b_i x_{it} + c_i x_{jt} + d_i I_t, \quad (i \neq j) \quad (1.3)$$

where

p_{it}^w = the average wholesale price of the i -th commodity, t -th year.

x_{it} = the per-capita supply (or consumption) of the i -th commodity, t -th year.

x_{jt} = the per-capita supply (or consumption) of a j -th competing or complementary commodity, t -th year.

I_t = the average per-capita consumer income, t -th year.

Again, the regression coefficients, namely, a_i , b_i , c_i and d_i , denote estimates of market parameters based upon time-series or cross-section data on the specified variables.

In addition, a vertical price relation is involved that shows an input price, p_{ijt} , as a function of output price, p_{it} . According to this version of market-price structure, raw material prices follow changes in product output prices; hence,

$$p_{ijt} = f_j + g_j p_{it}, \quad (1.4)$$

where

p_{ijt} = price of the i -th input or raw material, used in the j -th output, t -th year.

p_{it} = price of the i -th output commodity, t -th year.

g_j = vertical price coefficient, j -th output.

f_j = fixed margin coefficient, j -th output.

The vertical price coefficient, g_j , may be more than equal to or less than unity. The relative size of the vertical price coefficient will depend, first, on the units of measurement of inputs and outputs. This, of course, will affect the price per unit of input or output; hence, g_j may be thought of as a conversion factor. In any case, the vertical price coefficient shows the sensitivity of input price to a change in the output price.

Identities. To anticipate the requirements of the input-output matrix, the inputs purchased from the j -th sector by the i -th producing sector are shown as made up of two components, price and physical quantity. Thus, for any given period, the value of purchases from the j -th sector by the i -th producing sector is shown by the form,

$$X_{ij} = p_{ij} x_{ij}. \quad (1.5)$$

Similarly, the total value of output of any sector (i.e., the i -th sector) may be shown as price times quantity; i.e.,

$$X_i = p_i x_i. \quad (1.6)$$

The technical structure of the input-output matrix includes the coefficient, a_{ij} , which represents the proportion of the total value of purchases of the i -th industry from the j -th sector. Thus, the aggregate input-output coefficient is represented by the form,

$$a_{ij} = \frac{X_{ij}}{X_j}. \quad (1.7)$$

A coefficient of market disbursements may be constructed in the same manner as a coefficient of production in equation 1.7. As an intermediate market flow, the market disbursements represent the same technical structure as the production coefficient, but defined in terms of market outlet per unit of total disbursements. The market disbursement coefficient may be represented as,

$$k_{ij} = \frac{X_{ij}}{X_i}, \quad (1.8)$$

where

X_i = the total output of the i -th sector.

X_{ij} = market flow from i -th producing sector to j -th purchasing, or intermediate demand, sector.

Thus, k_{ij} may be expressed as a function of a_{ij} ;

$$k_{ij} = a_{ij} \left[\frac{X_j}{X_i} \right], \text{ if } i = j, \text{ then } k_{ij} = a_{ij}.$$

To show the relation between the production function and the quantities involved in the input-output matrix, the total output may be expressed by,

$$X_j = \sum_{i=1}^n k_{ij} X_i + X'_j, \quad (1.9)$$

where

X_j = physical output of the j -th sector (physical, as in constant dollars).

X'_j = net additional output of the j -th sector (same as equation 1.1).

k_{ij} = coefficient of market flow from i -th pro-

ducing sector to j-th purchasing, or intermediate demand, sector.

Equation 1.9 shows the physical quantity of output from the j-th sector as the sum of the physical quantities of inputs and the value added by the j-th producing sector.

Leontief system of interindustry transactions

In general form, the interindustry transactions and related matrices in the Leontief system are represented quite simply by a series of algebraic expressions. The total transactions of an industry (i.e., X_i) include the transactions with other industries,

$$\sum_{j=1}^n X_{ij}, \text{ and final users of the industry output, } Y_i.$$

These two categories are commonly described as intermediate demands and final demands, respectively, and are represented by the form,

$$X_i = \sum_{j=1}^n X_{ij} + Y_i. \quad (2.1)$$

The total purchases for any sector (i.e., X_j) are made up of the purchases from other industries in

the interacting sector of the economy, $\sum_{i=1}^n X_{ij}$, and

the primary input, V_j . These two types of purchases are represented by the form,

$$X_j = \sum_{i=1}^n X_{ij} + V_j. \quad (2.2)$$

The output of the i-th industry or sector available for final consumption, Y_i , may be represented by the form,

$$Y_i = X_i - \sum_{j=1}^n a_{ij}X_j, \quad (2.3)$$

where

Y_i = the final demand or final consumption of the i-th sector.

X_i = total output for sector i.

a_{ij} = the production coefficient.

The total purchases of the final demand sectors for the base year may be represented in matrix form by,

$$Y = X - AX, \quad (2.4)$$

where A = matrix of input-output coefficients, a_{ij} .

Equation 2.4 is not in a predictive form, however. To derive the level of output required that satisfies a given aggregate final demand under specified

conditions of production, as represented by the input-output technical structure matrix, the identity matrix is used. In matrix form, therefore, the total output of the interacting sectors of the economy is represented by,

$$X = (I - A)^{-1} Y. \quad (2.5)$$

For a complete description of matrix inversion or the solution of a Leontief system, refer to Heady and Candler (7) and Dorfman, Samuelson and Solow (5).

Market disbursements. If market disbursement is defined as the distributing of all products technologically capable of being produced with a given technical structure of interacting sectors and a predicted amount of primary factors available for use with the proper organization, a procedure similar to the preceding one may be used. In the one case, primary factors were assumed to be redundant; in the other case, it is assumed that market outlets are not exhausted.

The productivity of the j-th industry, X'_j , is defined as equal to total output of the j-th industry minus the intermediate demands; i.e.,

$$X'_j = X_j - \sum_{i=1}^n k_{ij}X_j. \quad (3.1)$$

Following the same procedure and a similar set of equations, the measurement of productivity, X' , may be used as a predictive tool in the sense that:

$$X' = X - KX, \text{ or} \quad (3.2)$$

$$X' = (I - K) X, \quad (3.3)$$

where

K = matrix of k_{ij} 's or market disbursement coefficients.

Hence:

$$X = (I - K)^{-1} X' \quad (3.4)$$

Equation 3.4 shows output as a function of intermediate technical structure and productivity.⁵ This formulation of the production relations has relevance to policy decisions. If such decisions were based upon estimates of the total production necessary for the delivery of a specified final demand, an overestimate of production may occur because of an increase in efficiency or organization, and a social waste would result. The output estimated from changes in final demand probably represents an upper limit to total output needed for a specified final demand.

Resource requirements. If data on unit-man-hour requirements (man-hours per unit of gross output) by sector are available, they can be applied to the inverse matrix to estimate the change in man-hour

5/ This formulation, however, assumes stability in the trading coefficients, which is less tenable than the corresponding assumption for the input-output coefficients.

requirements resulting from a change in final demand (44). For example, a fixed unit-man-hour requirement can be assumed for each sector; i.e.,

$$\frac{M_i}{X_i} = h_{ii}, \quad (4.1)$$

or,

$$M_i = h_{ii}X_i, \quad (4.2)$$

where

M_i = number of man-hours employed in the production of X_i .

h_{ii} = man-hour coefficient to produce one unit of X_i .

In matrix notation,

$$M = H \cdot X, \quad (4.3)$$

where H is a diagonal matrix representing a series of man-hour coefficients, h_{ii} . Using equation 2.5, and substituting into equation 4.3, results in,

$$M = H(I - A)^{-1} Y. \quad (4.4)$$

In equation 4.4, M indicates the total number of man-hours necessary to deliver the final demand Y .

By making one more assumption, namely that of profit maximization or equilibrium of the firm, specific values may be determined for the primary resources for any given level of output. From equation 2.4, for any level of final demand, Y , a total requirement vector, X , may be solved. Using this value in equation 3.4, the productivity vector, X' , may be found. This may also be done by making equation 2.5 equal to equation 3.4 and solving for X' . Thus,

$$X' = (I - K) (I - A)^{-1} Y. \quad (4.5)$$

Equation 4.5 shows that there is a certain level of primary resources, signified by the productivity vector, X' , that goes along with a specified level of final demand, Y .

Regional differentiation of technical structure

Since the construction of an interindustry table is expensive, aggregate coefficients based on the 1947 Bureau of Labor Statistics input-output study are used in regional breakdowns of interindustry data (6). The widespread use of the alternative approach merits a careful examination of the probable sources of variability in the aggregate coefficients.

Market relations. As was assumed for the aggregate case, a regional vertical market-price relation for the r -th region shows raw material prices following changes in product output prices; i.e.,

$$p_{ij}^r = f_j^r + g_j^r p_i^r. \quad (5.1)$$

The relation between regional output price, p_i^r , and raw material price, p_{ij}^r , is given by g_j^r . The regional fixed margin coefficient, f_j^r , again would be less than zero to provide a positive wholesaling or marketing margin.

The regional price relation shows a price differential as a result of transportation cost or quality, or both. An identical quality of products sold in the United States as a whole and in each of the regions would differ in price only by the cost of transportation from the surplus region of production to the deficit region of production. Hence, only the coefficient, T_i^r , would differ from one region to another. If quality difference occurred also, or if the price-making mechanism were less than perfect, then the regional price relation, m_i^r , would differ from unity. The regional price relation, therefore, is shown by the form,

$$p_i^r = T_i^r + m_i^r p_i, \quad (5.2)$$

where

p_i^r = regional price, i -th output, r -th region

p_i = national price, i -th output.

T_i^r = average cost of transportation, of i -th output for r -th destination region.

m_i^r = coefficient of quality difference or imperfect market structure, i -th output, r -th region.

Substituting equation 5.2 into equation 5.1, the regional input price is shown to follow the national price of the output commodity, thus:

$$p_{ij}^r = f_j^r + g_j^r (T_i^r + m_i^r p_i), \quad (5.3)$$

$$= f_j^r + g_j^r T_i^r + g_j^r m_i^r p_i.$$

Input-output relations. A unique regional input-output coefficient also exists. The regional input-output coefficient will be differentiated from the aggregate input-output coefficient by the superscript r . Hence, the relation of the regional input-output coefficient to the aggregate input-output coefficient is represented by the form,

$$\frac{a_{ij}^r}{a_{ij}} = \frac{\left(\frac{p_{ij}^r X_{ij}^r}{p_j^r X_j^r} \right)}{\left(\frac{p_{ij} X_{ij}}{p_j X_j} \right)}, \quad (5.4)$$

where all terms are defined as before.

In addition to the vertical price relations and the regional price relations cited earlier, a region's share of the total quantity of inputs purchased by a given sector may be represented by the form,

$$x_{ij}^r = h_{ij}^r x_{ij}, \quad (i, j = 1, \dots, n) \quad (5.5)$$

where h_{ij}^r is the coefficient of regional input to aggregate input.

A region's share of the total quantity of output of the i -th sector similarly may be represented by the form,

$$x_i^r = h_i^r x_i, \quad (5.6)$$

where h_i^r is the coefficient of regional output to aggregate output on a quantity basis. If the r -th region produces the entire aggregate amount, then h_i^r is equal to unity.

Identities. In an effort to analyze regional differences, several relations will be combined to note regional variability. Substituting equations 1.4, 5.1, 5.2, 5.5 and 5.6 into equation 5.4, and simplifying, yields the expression,

$$\frac{a_{ij}^r}{a_{ij}} = \frac{\frac{f_j^r}{T_i^r + m_i^r p_i} + g_j^r \left(\frac{h_{ij}^r}{h_j^r} \right)}{\frac{f_j}{T_i + m_i p_i} + g_j} \quad (5.7)$$

Thus, regional differences from the aggregate input-output coefficients are viewed as originating from differences in (a) vertical price relations within regions, (b) horizontal price relations among regions and (c) the region's share of total inputs and total outputs. If each region's share of total inputs purchased by a given sector is the same as its share of the total outputs of that sector, the market share ratio is unity. Moreover, if price changes are of like magnitudes among regions, then regional and aggregate price coefficients are equal. If there are no quality differences and perfect transmission of price changes between market levels, then the market coefficient is unity. The only difference, then, is the transportation cost and any differences in marketing margins between regions, f_j^r and f_j . If transportation costs did not exist and marketing margins were the same among regions, no difference would exist between the two expressions.

To use input-output analysis in a predictive manner, some estimate of final demand must be made. Since consumption is not broken down on a regional basis, final demand must be distributed to the various regions. In this study, an estimation equation was

used for the regional distribution of final demand of the form,

$$Y_{it+s}^r = Y_{it}^r + b_i^r (Y_{it+s} - Y_{it}), \quad (5.8)$$

where

Y_{it}^r = regional final demand for the i -th sector, t -th year.

Y_{it} = aggregate final demand for the i -th sector, t -th year.

Y_{it+s}^r = regional final demand for the i -th sector, $(t+s)$ -th year.

Y_{it+s} = aggregate final demand for the i -th sector, $(t+s)$ -th year.

b_i^r = the regional regression slope for the i -th sector.

The equation yields a least-squares estimate based on annual data. Unfortunately, regional data on final demand are not available on a yearly basis. For agriculture, however, adequate production data can be found on both an aggregate and regional basis.

Following equation 5.6, a corresponding equation for final demand may be written as,

$$Y_i^r = n_i^r Y_i, \quad (5.9)$$

indicating that regional final demand is a function of aggregate final demand. If h_i^r is equal to n_i^r , then production data can be used to estimate b_i^r and can be used in equation 5.8. To determine whether h_i^r equals n_i^r , equation 2.3 and a corresponding equation for regional final demand may be substituted into equation 5.9, yielding,

$$X_i^r = n_i^r X_i - n_i^r \sum_{j=1}^n X_{ij} + \sum_{j=1}^n X_{ij}^r. \quad (5.10)$$

For n_i^r to equal h_i^r , the form,

$$\sum_{j=1}^n X_{ij}^r = n_i^r \sum_{j=1}^n X_{ij}, \quad (5.11)$$

must hold; otherwise, the regional intermediate demand must be the same proportion, n_i^r , of the aggregate intermediate demand. If this can be assumed, or if it can be accounted for, production data may be used to estimate the regression, h_i^r in equation 5.7.⁶

6/ Alternatively, the Leontief, or (I-A) matrix, can be post-multiplied by the gross output vector, X , to obtain the final bill of agricultural goods, Y . The individual levels of Y can be evaluated, then, in terms of prospective markets—regional, national and foreign—needed to absorb the expected outputs.

Temporal differentiation of technical structure

Even if both production and consumption relations were stable for the economy, the technical structure may change over time because of changes in the values of the variables in the production and consumption functions. To show the sources of temporal variability in the technical structure of the economy, the components of the input-output matrix were differentiated with respect to time.

Using equations 1.5, 1.6 and 1.7 to show the basic operation in describing temporal changes of the technical structure, a partial derivative is obtained of the form,

$$\frac{da_{ij}}{dt} = \frac{d}{dt} \left(\frac{p_{ij}x_{ij}}{p_jx_j} \right) \quad (6.1)$$

Equation 6.1 indicates the infinitesimal change occurring in the technical coefficient, assuming a continuous function over time. Furthermore, by carrying out the operation on the right-hand side of equation 6.1 and simplifying, the following form results:

$$\frac{\Delta a_{ij}}{a_{ij}} = \frac{\Delta p_{ij}}{p_{ij}} + \frac{\Delta x_{ij}}{x_{ij}} - \frac{\Delta p_j}{p_j} - \frac{\Delta x_j}{x_j} \quad (6.2)$$

where the relative change Δa_{ij} , for example, is a

representation of the expression $\frac{da_{ij}}{dt}$. Equation 6.2

shows, therefore, that a temporal change in the input-output coefficient is the sum of the positive changes in input price and input quantities and the negative changes in output price and output quantities.

Market relations. Change from one period to the next may also be observed in the vertical price structure given in equation 1.4. Temporal change in the vertical price structure would be shown by the expression,

$$\Delta p_{ij} = g_j \Delta p_{i,j} \quad (6.3)$$

Input-output relations. Temporal change in the output variable of the production functions, either for product outputs or factor inputs, is represented by the form,

$$\Delta X_{j,i} = \sum_{i=1}^n k_{ij} \Delta X_i + \Delta X'_{j,i} \quad (6.4)$$

Substituting equations 6.3 and 6.4 into equation 6.2 and simplifying, yields the expression,

$$\frac{\Delta a_{ij}}{a_{ij}} = \Delta p_{i,j} \left(\frac{g_j}{p_{ij}} - \frac{1}{p_j} \right) + \frac{\Delta X_{j,i}}{X_{j,i}}$$

$$- \frac{\sum_{i=1}^n k_{ij} \Delta X_i + \Delta X'_{j,i}}{X_{j,i}} \quad (6.5)$$

In summary, temporal change in the aggregate or the regional input-output structure may arise from one or more of the following sources: (a) a disproportionate change in input and output prices; (b) a temporal change in the level of physical input purchases; (c) a temporal change in the total output of each sector which is, in turn, a function of its net output that may show temporal change; (d) a temporal change in the net output of the specified sector to which the input-output coefficient applies and which, in turn, is a function of all primary input variables that may show temporal change; or (e) a temporal change in prices of complementary and competing commodities when a price is a function of the prices of complementary or competing products.

Data Sources and Requirements

The numerical or quantitative core of the present analysis is based primarily on the data and procedure used by Masucci (17). The information in the Masucci report on sales and purchases of products between the farm and nonfarm segments of the United States economy and on sales and purchases within these major segments provides the most comprehensive data thus far brought together in this field.

Intersectoral transactions table

According to the intersectoral transactions table used in this study, agriculture is essentially dependent upon itself, upon industrial sectors from which it purchases material inputs and which process its material outputs, and upon the household segment which is the ultimate consumer and provides the primary factors of production. Agriculture is also differentiated regionally according to (a) production methods conditioned by various factors of which natural resources are most relevant and limiting or (b) a commodity basis of which marketing and processing conditions are factors or (c) a combination of the two.

Sectoral classification of agriculture. In input-output analyses, the classification of economic sectors consists of classifying industries into sectors according to uniformity of product output or factor inputs. The goal of classification is to have as much homogeneity of commodities within a sector as is consistent with maintaining a workable system.

Two general types of classification dominate in input-output methods. One is to classify according to type of industry or enterprise. The second is to classify according to commodities. The former case is generally the one occurring in manufacturing, while the latter is consistent with agriculture.

Sectoral classification of agriculture for the present study is the same as that given in Masucci's report (17). The agricultural economy is divided into 17 commodity groups plus one additional sector of agricultural services. Each commodity group is composed of one to several individual commodities. Table 1 contains the classification of agricultural commodities by sector name and sector number.

So far, nothing has been said about units of measurement. If each sector were composed of one commodity or if an acceptable index could be derived for a group of commodities, such as an index of nutritional value of different types of meat, physical units could be used in measurements (e.g., pounds of protein). However, since most sectors are composed of more than one commodity and since it is extremely difficult to compute a standard unit of measurement for different commodities, the method of physical measurements is seldom used. In addition to the problem of standard units for any particular sector, physical units are not necessarily additive between sectors. The present study has used producers' value as opposed to the alternative of purchasers' value.

Flow matrix. One of the main attributes of the

Table 1. Classification of agricultural commodities by sector name and input-output sector number.

Input-output sector number	Sector name	Commodities
1 -----	Meat animals	Cattle and calves, hogs, sheep and lambs, goats, hides and manure
2 -----	Poultry and eggs	Chickens, broilers, turkeys, eggs, other poultry
3 -----	Farm dairy products	Milk
4 -----	Other livestock and products	Wool, mohair and other hair, horses and mules, honey, package bees, beeswax, misc. animals
5 -----	Food crops	Wheat, rice, rye, buckwheat
6 -----	Feed crops	Corn, hay, oats, barley, sorghum grain
7 -----	Cotton	Cotton, cottonseed
8 -----	Tobacco	Tobacco
9 -----	Oil-bearing crops	Soybeans, peanuts, flaxseed, castor beans, tung nuts
10 -----	Vegetables	Dry edible beans, dry edible peas, potatoes, sweetpotatoes, truck crops, mung beans
11 -----	Fruits	Fruits, berries
12 -----	Tree nuts	Tree nuts
13 -----	Legume and grass seeds	Cowpeas, hayseeds, pasture seeds, cover crop seeds, other seeds
14 -----	Sugar and sirup crops	Sugar beets, sugar cane, maple products, sorgo sirup
15 -----	Miscellaneous crops	Hops, spearmint and peppermint, broomcorn, flax, hemp, popcorn, velvetbeans
16 -----	Forest products	Forest products
17 -----	Greenhouse and nursery products	Horticultural specialties, sod, forest seedlings, roots and herbs
18 -----	Agricultural services	Hatcheries, artificial insemination, animal husbandry, seed certification, soil testing, customwork and machine hire, ginning, sirup tolls

input-output approach is its advantage for organizing a large amount of data in a systematic way. The flow matrix is an outgrowth of the accounting procedure used in input-output analysis. (The mathematical form of the flow matrix was given earlier in equation 2.1.)

The agricultural segment of the economy will be described in this procedure. The agricultural segment may be termed as a subset within the entire economy. The 18 sectors within agriculture represent 18 producing sectors and 18 purchasing sectors. In addition to the 18 agricultural sectors—17 production sectors plus one service sector—one more purchasing sector is established that includes the nonagricultural purchases of farm commodities. Also, one more producing sector or row is added which comprises all additional inputs to agriculture that originate outside of agriculture. These inputs include, not only industrial inputs, but also primary factors such as labor and proprietary income.

Direct requirements matrix. One of the basic assumptions of input-output analysis is that a constant parameter describes the relationship between any input and the corresponding output. The mathematical form of this relationship for a specific input-output coefficient is given in equation 1.7. The entire system of equations expressing the technical structure incorporated within the input-output framework is given by equations 2.3 and 2.4.

The inverse: direct and indirect requirements. In the flow matrix of the agricultural interdependence model, total output is a function of agricultural intermediate demand and nonagricultural intermediate and final demand. The direct requirements matrix shows any specific sector's total output as a function of all other agricultural sector's total output and non-agricultural demand. By making the final demand, or what is termed all nonagricultural demand in this model, an exogenous part of the model, total output can be described as a function of the total interdependence matrix and the exogenous portion of the model. Since the total interdependence matrix is composed only of the technical relations constructed for the direct requirements matrix and is considered constant, total output is only a function of this constant times the exogenous part of the model.

Final demand and primary input sectors

The model may be extended now to include the dependence of the 18 agricultural sectors upon the industrial and primary sectors for factor purchases and upon the industrial and final demand sectors for product purchases. These two components are the exogenous parts of the model that can be multiplied by the technical structure to obtain estimates of total production among the 18 agricultural sectors.

Sectoral classification. The industrial classification

of sectors is in two parts. One classification is according to rows, and the other classification is by columns in the input-output tables. The classification for the present study is essentially the same as that given in (17, pp. 29-31). Two main industrial classifications are distinguished, with each disaggregated into a number of rows. One main classification is "Total Manufacturing" which is decomposed into 15 separate rows. The other main group is that of "Total Services," composed of nine separate rows. Each row represents an aggregate of similar industries according to the Standard Industrial Classification (21).

One difference in the present classification from that given by Masucci (17) is in the row sector of chemicals and allied products. This sector is divided into "Chemical Products I," composed of industries designated 2819, 29, 30, 70, 97, 98 and 99 in the Standard Industrial Classification, and "Chemical Products II," composed of Standard Industrial Classification industries 2881, 82, 83, 85 and 86 (the output of the oilmeal industries). The purpose in dividing this sector arises from the importance of the oilmeal industries in the livestock economy. Table 2 gives the row classification of the industrial sectors by sector name and number.

Column classification of industries is similar to that given by Masucci (17), but some sectors have

Table 2. Row classification of industrial sectors by sector name and input-output sector number.

Row sector	Sector name	Standard industrial classification
<i>Manufacturing:</i>		
19	Bituminous coal	1210
20	Mining of nonmetallic minerals (except fuels)	1422, 72, 75
21	Food and kindred products	2041, 42, 44, 62, 63, 82, 85, 94
22	Textile mill products	2220, 2297
23	Finished textile products	2393, 94
24	Wood products	2440, 45
25	Paper products	2612, 40
26	Printing and publishing	2700
27	Chemical products I	2819, 29, 30, 70, 97, 98, 99
28	Chemical products II	2881, 82, 83, 85, 86
29	Petroleum products	2911
30	Rubber products	3011
31	Stone, clay and glass products	3221, 60, 74, 95
32	Fabricated metal products	3411, 22, 23, 89, 91, 9920
33	Machinery and parts	3521, 27, 59, 9910
<i>Services:</i>		
34	Utilities	4911, 22, 25, 71
35	Margin industries	N167, N168, N169.1, N169.3, N171, N173, N174, N175.1, N176, 9010, 9020
36	Telephone	N191
37	Finance	N197.1, N198.3
38	Farm nonresidential rents	N199.2
39	Misc. farm business expenses	N203, N211, 9913
40	Repair services	N205, N206.4
41	Nonprofit membership organizations	N213
42	Construction	N244

Table 3. Column classification of industrial sectors by sector name and input-output sector number.

Column sector	Sector name	Standard industrial classification
<i>Manufacturing:</i>		
19	Meat packing	2010
20	Poultry, wholesale	2015
21	Processed dairy products	2020
22	All other food and kindred products	2032, 33, 34, 35, 37, 41, 42, 43, 44, 51, 52, 61, 63, 71, 72, 82, 83, 84, 85, 90, 92, 94, 95, 96, 99
23	Tobacco manufacturing	2111, 31, 41
24	Textile mill products	2210, 20, 50, 71, 93, 97, 99
25	Wood products	2421, 2510, 2611
26	Chemical and allied products	2829, 30, 40, 62, 65, 70, 81, 82, 83, 84, 92, 97, 99
27	Leather tanning and other misc. industries	3111, 3981, 92
<i>Services:</i>		
28	Eating and drinking places	5810
29	Hospitals and education	8061, 8210
30	Construction	N244
31	All other services	N167, N170, N173, N169.3, N191, N192

been disaggregated; in particular, the food and kindred products sector and other sectors have been disaggregated. Table 3 gives the column classification of the industrial sectors.

Primary factors of production represent what is usually termed "value added" in any particular sector. After all material inputs are designated in the production of any commodity, there remain inputs of labor, management, depreciation and other items that may be termed primary resources or those contributed by the "household" sector. Other items that often are included in this sector are foreign inputs, federal, state and local government inputs. These factors are not included in the total interaction matrix but are assumed to be given or forthcoming for any given output that is a direct function of final demand. Table 4 gives the classification of primary input.

Table 4. Classification of final demand and primary inputs by sector name and input-output sector number.

Sector number	Sector name	Standard industrial classification
32	Final demand	
	Foreign trade	9100, 9104
	Federal government	9010
	State and local government	9020
	Gross private capital formation	7935
	Inventory change	9941, 40, 53, 43
	Households	9500
43	Foreign trade	9100
44	Federal government	9010
45	State and local government	9020
46	Households	9500
46.1	Wages and salaries	
46.2	Proprietors' income	
46.3	All other	

Final demand in the Masucci (17) report is decomposed into six sectors. For purposes of this report, final demand will be one sector. Table 4 also gives the classification of final demand.

Factor purchases. Flows of inputs into agriculture from industrial and primary sectors may be read off directly from the flow matrix. Agriculture is an important market for many industrial goods and services and also requires labor and management skills from the primary sectors.

Product sales. Agriculture also is dependent upon the industrial and final demand sectors as market outlets for its products. For the agricultural interdependence model, no differentiation was made between market outlets between the industrial and final demand sectors for agricultural products. However, to establish the potential industrial markets for agricultural products, it is necessary to disaggregate into specific markets. Therefore, the industrial segment was decomposed into 13 sectors according to the column classification given previously.

Regional and interregional models

One of the major objectives of this study is to prepare an intersectoral transactions table for measuring the impact of changes in the agricultural segment and related sectors upon the economic activity of a region. For this reason, the models so far described will be carried out on a regional and subregional basis.

For purposes of this study, the United States was disaggregated into two major regions, the North Central States and all other states. The North Central Region accounts for 51 percent of the total livestock production and 41 percent of the total crop production of the United States. Because of the relative importance of this region for the production of agricultural commodities, any change in the demand for agricultural products will be of tremendous importance, not only to the agricultural segment of the economy, but also to all sectors that deal directly or indirectly with agriculture.

Contrasted to the North Central Region are all other regions combined. Even though total agricultural production is large for the other regions, it is not as important to the over-all regional economy as is production in the North Central Region.

Figure 2 illustrates a further subregional breakdown of the North Central Region. The 12 states in the region are included among three subregions—with North Dakota, South Dakota, Nebraska and Kansas in the Northern Plains subregion; Minnesota, Iowa and Missouri in the Western Corn Belt; and Wisconsin, Illinois, Michigan, Indiana and Ohio in the East North Central subregion.

The Northern Plains subregion is characterized by the production of food crops, such as wheat and rye, and in the production of meat animals, particularly feeder cattle. The Western Corn Belt is a major pro-

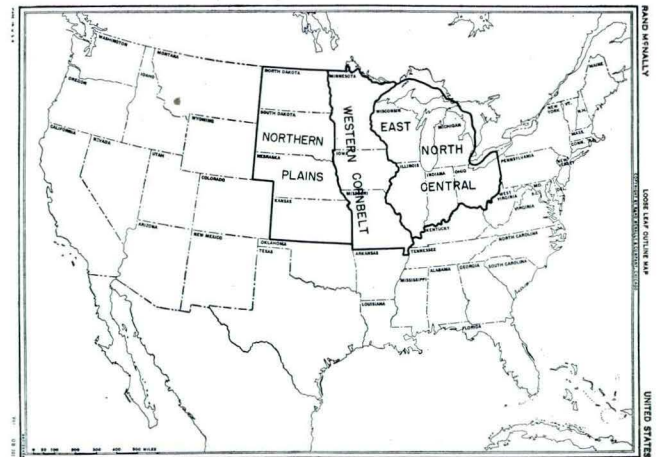


Fig. 2. North Central Region and subregions.

ducer of meat animals, with Iowa by far the most important single producer of hogs. Feed crops make up another relatively important sector in this subregion. Dairying and feed-crop production are the more important sectors of the East North Central subregion.

The geographic distribution of agricultural processing establishments is another important factor in considering regional growth patterns. The East North Central subregion has long been established as a major processing center, especially of meat animals. However, new facilities have been established in the area of production of these commodities. Hence, processing plants are being established in the Western Corn Belt and the Northern Plains.

Data Manipulation

To facilitate the location of particular data on intersectoral flows and demands, an abbreviated format of an interindustry transactions table has been prepared (table 5a). In the summary table, each of the intersectoral tables in this report is identified by number. For example, data on gross agricultural output in the North Central Region are summarized in tables 11 through 13, table 17, and tables 38 and 39. Data on intra-agricultural transactions are summarized in tables 18 through 21 and tables 30 through 35. Because of the emphasis on the agricultural sectors, data on intrasectoral commodity flows in the manufacturing and service sectors as well as in the final demand sectors are not included in this report.

The tabular data for the North Central Region have been aggregated and summarized in table 5b simply to illustrate the use of the detailed data in estimating prospective regional requirements for agricultural products. First, however, one modification has been made in the format of table 5a; namely, the breakdown of agriculture into two major sectors—animal products and other outputs (primarily crops). According to the summary data, the gross 1955 output (including intrasectoral transfers) of the animal products sectors in the North Central Region was

Table 5a. Location of interindustry transactions tables by number with reference to major categories of data.

Major producing sectors	Sector numbers	Major purchasing sectors			
		Agriculture 1-18	Manufacturing and services 19-31	Final demands 32	Total output 1-32
Agriculture	1-18	18-21	41	14, 15	11-13, 17, 38, 39
Manufactured products and services	19-42	30-35		36, 37	
Primary inputs	43-46	22, 24, 26, 28, 40			
		23, 25, 27, 29, 42			

Table 5b. Estimated flows of goods and services to and from agriculture in the North Central Region, 1955.

Major sector	Sector numbers	Intermediate demands			Final demand ^a 19-32	Total output 1-32
		Animal products 1-4	Crops and other 5-18	Total 1-18		
Animal products	1-4	(\$1,000) 1,297,061	(\$1,000) 41,483	\$1,000 1,338,544	(\$1,000) 8,010,127	(\$1,000) 9,348,671
Crops and other	5-18	4,074,157	583,486	4,657,643	4,182,687	8,840,330
Manufactured products and services	19-42	1,908,542	3,060,047	4,968,589	--	--
Primary inputs	43-46	2,068,911	5,155,314	7,224,225	--	--
Total purchases	1-46	9,348,671	8,840,330	18,189,001	--	--

a/ Final demand including market disbursements.

\$9,348,671,000 while the corresponding output for the crop and other output sectors was \$8,840,330,000. Only \$1,338,544,000 of the animal products output was utilized within the agricultural sectors; the remainder of this output was utilized by different manufacturing and service sectors, and, also, by households making purchases directly from the agricultural sectors. On the other hand, the animal products sector acquired \$1,297,061,000 worth of its own output and an additional \$4,074,157,000 worth of products from other agricultural sectors. Purchases from the manufacturing and service sectors and the primary input sectors were about equally divided, as shown in table 5b.

As indicated in the discussion of the Leontief system of interindustry transactions, the estimates of gross output are based on the use of the inverse, $(I-A)^{-1}$. First, however, the purchases from each sector specified in table 5b are divided by the total purchases of a given sector to obtain the input-output coefficients cited in equation 1.7 (see table 5c). The input-output coefficients now denote the levels of specified purchases per million dollars of gross output. For example, the summary data show that the animal products sector acquires \$138,743 worth of

products from its own detailed sectors per million dollars of total purchases.

To illustrate the use of the data in the two tables in the context of equation 2.1, the total purchases of the j-th sector are multiplied by the corresponding input-output coefficient (which is divided by 10^6 as a coding procedure) and then added to the estimated final demand. The outcome of the multiplication is the gross output, which is equal to total purchases.

Alternatively, the input-output coefficient may be subtracted first from "one" or "zero" and then multiplied by gross output to obtain final demand, as shown:

$$\begin{bmatrix} 8,010,127 \\ 4,182,687 \end{bmatrix} = \begin{bmatrix} 0.861257 & -0.004692 \\ -0.435801 & 0.933997 \end{bmatrix} \begin{bmatrix} 9,348,671 \\ 8,840,330 \end{bmatrix}$$

The multiplication is prescribed by the matrix equation

$$Y = (I-A)X,$$

which can be represented numerically by the procedure,

$$8,010,127 = (0.861257) (9,348,671) - (0.004692) (8,840,330)$$

and

$$4,182,687 = - (0.435801) (9,348,671) + (0.933997) (8,840,330).$$

In this report, final demand projections are presented for 1975, along with the technical structure of agriculture for 1955. Thus, the final demand is given, while gross output is estimated by use of equation 2.4.

Table 5c. Direct requirements coefficients of agricultural sectors in the North Central Region, 1955.

Major producing sectors	Sector numbers	Animal products 1-4	Crops and other 5-18
Animal products	1-4	\$ 138,743	\$ 4,692
Crops and other	5-18	435,801	66,003
Manufactured products and services	19-42	204,151	346,146
Primary inputs	43-46	221,305	583,159
Total purchases	1-46	1,000,000	1,000,000

To illustrate the procedure using 1955 final demand estimates, it is necessary, first, to obtain the inverse of the Leontief or (I-A) matrix. The inverse, (I-A)⁻¹, is then multiplied by the final demand vector, Y, to obtain gross output.

In summary, therefore, equation 2.4 can be represented by the matrix form,

$$\begin{bmatrix} 9,348,671 \\ 8,840,330 \end{bmatrix} = \begin{bmatrix} 1.164052 & 0.005848 \\ 0.543144 & 1.073395 \end{bmatrix} \begin{bmatrix} 8,010,127 \\ 4,182,687 \end{bmatrix},$$

or by the numerical procedure,

$$9,348,671 = (1.164052) (8,010,127) + (0.005848) (4,182,687)$$

and

$$8,840,330 = (0.543144) (8,010,127) + (1.073395) (4,182,687).$$

Finally, the inverse matrix contains the short-run regional multipliers that can be used to relate changes in final demands to both direct and indirect changes in agricultural outputs. For example, a \$1 increase in the final demands (including manufacturing and services) for the outputs of the animal products sector would result in a \$1.16 *direct* increase in the gross output of animal products and a \$0.543 *indirect* increase in the gross of crops and other products. The \$1.16 *direct* increase in output is necessary because of the occurrence of intrasectoral transfers of \$0.138 per \$1 of gross output. Thus, to deliver \$1 of gross output into the final demand sectors, at least \$1.138 of total output must be produced.

As a result of the increase in animal products output to meet the \$1 increase in the demand for animal products, the crop and other output sectors will experience an increase in their derived demands because of the technical interdependencies among the two major sectors (see table 5b). For example, the \$1.138 first-round *direct* increase in total animal products output would require a \$0.617 (since \$1.138 x \$0.543 = \$0.617) *indirect* increase in the output of the second major sector. The later increase, in turn, requires an additional small increase in the output of the first sector because of the technical interdependencies. The second-round *direct* increase in output requires a further *indirect* increase in output, which, again, results in further incremental adjustments until the iterative process "zeros-in" on the equilibrium levels (namely, the estimates given in the inverse matrix). In this way, the 1955 interindustry transactions matrix can be used in estimating the total *direct and indirect* requirements to meet a projected level of final demand (including manufacturing) for each of the specified agricultural sectors.

The use of a 1955 pattern of interindustry relations gives, of course, a series of output projections based on the assumption of fixed input-output coefficients

for the projection period. The assumption of stability in input-output coefficients is one that can be modified to some extent by projecting secular changes in these coefficients. However, data were not available for this study to prepare an input-output table based on projected changes in the pattern of interindustry transactions in each of the regions. Hence, the projected agricultural outputs can be translated into estimates of specific input requirements only in terms of the given input-output structure.

PROJECTED DEMANDS FOR AGRICULTURAL PRODUCTS

To use the technical data in projecting north central agriculture for some future period, say 1975, the final demand vector must be estimated. Thus, given the projected final demands for north central agricultural products and the technical structure of north central agriculture, the gross agricultural output for the region can be obtained.

In this report, we assume that the 1955 technical structure of agriculture is a reasonably close approximation of the future agricultural structure. In any case, the final demand estimates are the primary basis for the 1975 estimates of agricultural output. These estimates are presented, first, for the United States and, finally, for the North Central Region and the three subregions — East North Central, Western Corn Belt and Northern Plains.

Analytical Procedures

Rogers and Barton (19) have estimated national requirements from agriculture by 1975 for many of the more important commodities. In that study, the change in projected requirements for 1975 from the base period of 1956-58 is a function of the projected change in personal disposable income, population numbers and distribution, export and import balance, trends in consumer preferences, industrial needs and the demand from the government sector of the economy.

Since Rogers's and Barton's agricultural production estimates are used for this study, their specific assumptions will be given. The projections were based on 1957 price levels. The increase in demand in 1975 over the base period was computed chiefly from the projected increase in population. A moderate increase in over-all per-capita use of farm products was projected after considering demand characteristics of various farm products, the projected increase in disposable personal income and projections of trends in consumer tastes. The requirements were based on a United States population of 230 million. The level of exports of farm commodities was projected on the assumption of approximately 1956 world price levels for major export crops.

Projected requirements for livestock production are 45 percent above actual production in 1956-58. Crop production would need to rise by 25 percent

above 1956-58. This difference is due in part to the tendency for meat consumption to rise with income. The smaller increase projected for crop production also is due to production in excess of market utilization of a number of major crops during the base period as well as to the projected increase in efficiency of feed use by livestock.

The estimates of agricultural requirements for 1975 are, for the most part, based on national estimates prepared by the United States Department of Agriculture. Where estimates were not available, however, per-capita consumption was explained by a linear regression model that included personal disposable income and a trend variable. If per-capita consumption did not vary from year to year, average consumption was used with the projected population by 1975.

The next step was to establish some regional production allocation rules. As has been mentioned, consumption was defined only on a national level, but production was defined by regions. Since final demand for purposes of this study has been defined as that portion going to the intermediate processing sectors as well as that going for final use, the regional production rules are assumed to hold also for the regional distribution of final demand.

The model used in this study may be expressed by four equations: a behavioral equation, expressing a region's production in terms of the national production; a definitional equation, describing final demand; a regional market-share equation; and an equation expressing projected regional final demand in 1955 base year prices. Each agricultural commodity then is represented by the four equations:

$$X_t^r = a + b X_t^{rUS} \quad (7.1)$$

where

- X_t^r = regional physical production in year t,
- X_t^{rUS} = national physical production in year t,
- b = coefficient of change in regional production associated with a 1-unit change in national production,
- a = constant term or intercept value.

$$Y_{1955}^r = X_{1955}^r - I_{1955}^r \quad (7.2)$$

where

- Y_{1955}^r = regional physical final demand in the base year,
- X_{1955}^r = regional physical production in the base year,

I_{1955}^r = sum of the regional intermediate demand in the base year.

$$Y_{1975}^r = Y_{1955}^r + b (Y_{1975}^{rUS} - Y_{1955}^{rUS}), \quad (7.3)$$

where

Y_{1975}^{rUS} = estimated national requirements in 1975,

$b (Y_{1975}^{rUS} - Y_{1955}^{rUS})$ = the region's market share of the increased national requirements,

Y_{1975}^r = estimated regional final demand in 1975.

$$Y_{1975}^{r*} = p_{1955}^r Y_{1975}^r \quad (7.4)$$

where

p_{1955}^r = regional price of the commodity in 1955,

Y_{1975}^{r*} = 1975 projected regional final demand valued at 1955 prices.

Aggregate Demand and Output Estimates

The agricultural projections are broken down into livestock products and crops. In both cases, estimated farm output is shown. Later, the output data will be used to estimate prospective regional demands for agricultural products.

Livestock and livestock products

The four sectors included under this major category are identified further by a detailed commodity classification in table 6. The commodity estimates are on a physical basis. Each series of commodity estimates is described with reference to data sources and the underlying assumptions.

Meat animals. The gross output estimates of cattle, calves, hogs and sheep include (a) farm production, (b) inshipments and (c) inter-farm sales. Inshipments and interfarm sales are based on the Masucci study (17). Projected total production for 1975 is based, moreover, on the same ratio as that existing between the estimated 1955 slaughter and the projected 1975 slaughter.

According to the estimates reported in table 6, the gross farm output of cattle in 1955 was nearly twice as large as the gross farm output of hogs. By 1975, the output disparity is expected to be even greater: Total farm production of cattle and calves is estimated at 62,895,000,000 pounds liveweight compared with 30,827,000,000 pounds liveweight of hogs. Because of the double counting in the gross output estimates, they would be larger than the slaughter

Table 6. Estimated production of specified livestock items, United States, 1955 and 1975.

Sector	Item	Units	Estimated 1955	Projected 1975	Projected change 1955-75	Projected 1975 as percent of estimated 1955
1	Meat animals (gross output)					
	Cattle and calves	Mil. lbs.	39,477	62,895	23,418	159.3
	Hogs	Mil. lbs.	20,274	30,827	10,553	152.1
	Sheep and lambs	Mil. lbs.	2,236	3,106	870	138.9
1	Meat animals (slaughter)					
	Cattle and calves	Mil. lbs.	27,747	44,207	16,460	159.3
	Hogs	Mil. lbs.	19,271	29,302	10,031	152.1
	Sheep and lambs	Mil. lbs.	1,585	2,202	617	138.9
2	Poultry and eggs					
	Farm chickens	Mil. lbs.	1,632	813	-819	49.8
	Broilers	Mil. lbs.	3,309	7,283	3,974	220.1
	Turkeys	Mil. lbs.	1,090	2,232	1,142	204.8
	Eggs	Mil. doz.	4,958	6,976	2,018	140.7
	Other poultry	Thou. dol.	36,996	43,084	6,088	116.5
3	Farm dairy products	Mil. lbs.	123,128	171,500	48,372	139.3
4	Other livestock	Thou. dol.	305,027	352,168	47,141	115.5
	Wool	Thou. dol.	130,015	179,634	49,619	138.2
	Mohair and other hair	Thou. dol.	13,912	13,912	0	100.0
	Horses and mules	Thou. dol.	14,431	7,215	-7,216	50.0
	Honey	Thou. dol.	45,031	49,534	4,503	110.0
	Beeswax	Thou. dol.	2,348	2,583	235	110.0
	Package bees	Thou. dol.	1,007	1,007	0	100.0
	Miscellaneous animals	Thou. dol.	98,283	98,283	0	100.0

estimates (but only slightly larger in the case of hogs).

Poultry and eggs. Farm production of poultry and eggs includes farm chickens, broilers, turkeys and miscellaneous products as well as eggs. The estimates by Daly (4) serve as a basis for the projected output of farm chickens and broilers (reported together in the Daly estimates). In this study, a prediction equation, $Y = 4,009 - 0.3947X$, was used to estimate the farm production of chickens, Y, given the combined output of farm chickens and broilers, X. Thus, farm chickens are expected to make up a smaller and smaller proportion of the total output of chickens.

Since national estimates of turkey production were not available from other sources, the 1955 to 1975 percentage increase of chicken production times an additional growth factor of 1.3 was used to obtain the projected 1975 turkey production. Finally, the miscellaneous poultry products were assumed to increase in the same proportion as the aggregate poultry and eggs sector.

Farm dairy products. With reference to farm dairy products, an inelastic demand means a relatively low rate of increase in milk consumption—a rate that is roughly equivalent to population growth. Hence, only a 39.3 percent increase in aggregate milk production was assumed for purposes of the regional estimates of milk requirements.

Other livestock. Miscellaneous livestock and livestock products are of secondary importance. Thus, the relative change in the secondary products was assumed to be the same as for the corresponding primary products. However, mohair and other hair along with miscellaneous fur animals were assumed to remain constant. Horses and mules were expected to decrease by 50 percent from 1955 to 1975. For all items, producers' dollar value, rather than a measure of physical output, was used.

Crops and miscellaneous items

Estimated 1975 output of crops and other items were obtained from Rogers and Barton (19). Since these estimates are discussed elsewhere, they are merely summarized in table 7.

Regional Production Equations

As indicated in equations 7.1-7.4, a homothetic model was used to estimate regional output, given the projected national output. Time series data for the 1949-60 period were used in fitting the simple regression model.

Livestock and livestock products

A prediction equation was prepared for each of the livestock classes cited in table 8. For the most part, the correlation between the regional variable and the corresponding national variable was quite satisfactory, as revealed by the high values of the correlation coefficients and the close fit of the individual annual observations, illustrated in fig. 3. The projected levels of regional output are represented in fig. 3 as extrapolations of the trend line to its intersection with the coordinate denoting the estimated 1975 level of the particular production item.

Data limitations forced modifications in the estimation procedures. Where adequate data were available on a state basis, the homothetic function, equation 7.1, was estimated with physical production data. However, if aggregation problems occurred, or if physical data were not available, only the estimated cash receipts from farm marketings remained as a basis for estimating the functional relationships. If year-to-year variations in the data were not sufficiently explained by the prediction equation (i.e., if a low correlation coefficient occurred), an estimated average level of output for a specified time period was used. The latter procedure was used only with

Table 7. Estimated production of specified crop and miscellaneous items, United States, 1955 and 1975.

Sector	Item	Units	Estimated 1955	Projected 1975	Projected change 1955-75	Projected 1975 as percent of estimated 1955
5	Food grains					
	Wheat	Thou. bu.	938,159	1,090,020	151,861	116.2
	Rice	Thou. cwt.	55,902	57,960	2,058	103.7
	Rye	Thou. bu.	29,187	28,050	-1,137	96.1
	Buckwheat	Thou. bu.	2,055	2,055	0	100.0
6	Feed crops					
	Corn	Thou. bu.	3,184,836	4,411,830	1,226,994	138.5
	Hay	Thou. tons	109,697	143,668	33,971	131.0
	Oats	Thou. bu.	1,575,736	1,599,860	24,124	101.5
	Barley	Thou. bu.	390,969	706,420	315,451	180.7
	Sorghum	Thou. bu.	232,638	381,520	148,882	164.0
7	Cotton					
	Cotton	Thou. lbs.	7,360,500	9,096,800	1,736,300	123.6
	Cottonseed	Thou. tons	5,800	7,168	1,368	123.6
8	Tobacco	Thou. lbs.	2,193,033	2,689,200	496,167	122.6
9	Oil-bearing					
	Soybeans	Thou. bu.	373,522	549,010	175,488	147.0
	Peanuts	Thou. lbs.	1,575,840	2,115,000	539,160	134.2
	Flaxseed	Thou. bu.	41,243	48,960	7,717	118.7
	Castor beans and tung nuts	Thou. dol.	1,429	1,786	357	125.0
10	Vegetables					
	Dry edible beans	Thou. cwt.	17,287	21,255	3,968	123.0
	Dry edible peas	Thou. cwt.	2,525	3,370	845	133.5
	Potatoes	Thou. cwt.	227,046	261,240	34,194	115.1
	Sweetpotatoes	Thou. cwt.	20,946	24,750	3,804	118.2
	Truck crops	Thou. dol.	1,634,669	2,342,106	707,437	143.3
11	Fruits	Thou. dol.	1,239,455	1,740,838	501,383	140.5
12	Nuts	Thou. dol.	128,137	183,112	54,975	142.9
13	Miscellaneous crops	Thou. dol.	1,526,750	1,971,846	445,096	129.2
14	Agricultural services	Thou. dol.	1,128,926	1,594,278	465,352	141.2

Table 8. Prediction equations for specified livestock and estimated changes in production, North Central Region, 1955-75.^a

Item	Region and subregion	Regression coefficient r	Projected change in production	Average farm price	Estimated value of change in production
		(units)	(units)	(\$)	(\$1,000)
Cattle and calves	North Central	0.4796	11,231	0.1673	1,878,946
	N. Plains	0.1762	4,126	0.1648	679,965
	W. Corn Belt	0.1765	4,133	0.1753	724,515
	E. North Central	0.1269	2,972	0.1617	480,572
Hogs	North Central	0.7285	7,688	0.1463	1,124,754
	N. Plains	0.1684	1,777	0.1433	254,644
	W. Corn Belt	0.3274	3,456	0.1437	496,627
	E. North Central	0.2327	2,455	0.1505	369,478
Sheep and lambs	North Central	0.5189	451	0.1707	76,986
	N. Plains	0.2298	200	0.1740	34,800
	W. Corn Belt	0.1766	153	0.1727	26,423
	E. North Central	0.1125	98	0.1652	16,190
Farm chickens	North Central	0.5472	-448	0.1670	-74,816
	N. Plains	0.1130	-93	0.1460	-13,578
	W. Corn Belt	0.1853	-152	0.1560	-23,712
	E. North Central	0.2489	-203	0.1870	-37,961
Commercial broilers	North Central	0.0541	215	0.2510	53,965
	N. Plains	—	82	0.2550	20,910
	W. Corn Belt	0.0205	49	0.2440	11,956
	E. North Central	0.0344	84	0.2530	21,252
Turkeys	North Central	0.6001	685	0.3000	205,500
	N. Plains	0.0312	36	0.2910	10,476
	W. Corn Belt	0.3883	443	0.2970	131,571
	E. North Central	0.1807	206	0.3090	63,654
Egg production	North Central	—	2,313,333	33.00	763,400
	N. Plains	—	443,667	29.70	131,769
	W. Corn Belt	—	911,167	31.90	290,662
	E. North Central	—	958,499	35.50	340,267
Milk production	North Central	0.4293	20,766	3.190	662,435
	N. Plains	—	-199	2.710	-5,393
	W. Corn Belt	0.1794	8,367	2.940	245,990
	E. North Central	0.2701	12,598	3.430	432,111
Other livestock	North Central	0.4653	21,935	—	21,935
	N. Plains	—	-2,694	—	-2,694
	W. Corn Belt	0.0880	-11,289	—	-11,289
	E. North Central	—	35,918	—	35,918

a/ Units refer to those specified in table 6.

the products accounting for a small proportion of total production.

Prediction equations thus were prepared for individual commodities within each of the 18 agricultural sectors. The data for the prediction equations were obtained on a state-by-state basis and then summarized on a subregion basis. Sources of data are much

the same as given by Masucci (17) in his work tables of the individual sectors. Total physical production, where it is used, was multiplied by the average price received by farmers in the subregion to obtain the total value of production of each commodity in that region.

The projected change in production for a particular

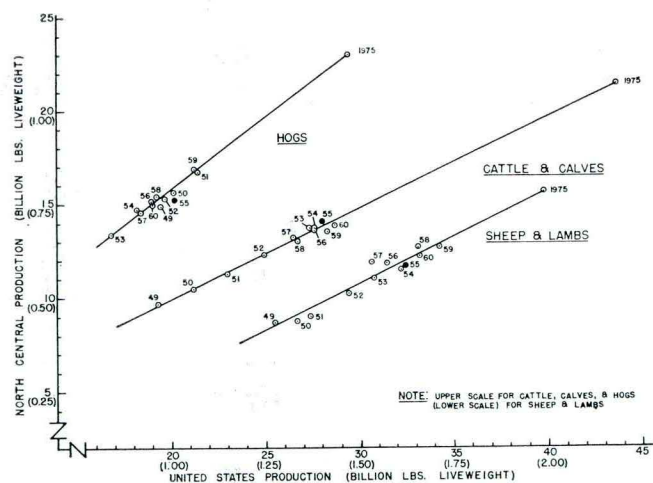


Fig. 3. Regional trends in selected livestock production, 1949-75

region is obtained by multiplying the projected change in national production (table 8) by the regression coefficient, b^r , for the specified region. If the projected national production is given by physical units, then the product of the variable and the coefficient is multiplied by the specified average farm price for the item. In this way, projected changes in gross output were obtained for the North Central States and for each of its three subregions.

An examination of the regression coefficients in table 8 will reveal a high degree of concentration of livestock production in the North Central States. For example, 48 percent of the projected increase in cattle and 73 percent of the projected increase in hogs occur in the North Central Region, according to the prediction equations. The region's production of sheep and lambs, farm chickens, turkeys, milk and other livestock also is quite important nationally.

Within the North Central Region, sharp geographical differences occur in the relative importance of different classes of livestock. The Western Corn Belt, for example, is expected to have 33 percent of the national increase in hog production and 39 percent of the national increase in turkey production. The Northern Plains, however, has only half of the increase of the Western Corn Belt in hog production and less than one-twelfth of its increase in turkey production.

Besides geographical differences in total output, table 8 shows geographical differences in average farm prices. The latter are the result of differences in the quality of livestock and location with reference to final consumption. Given an identical quality of livestock and perfect market knowledge, the geographical price differences would be based entirely on transportation cost differentials. Assuming that agricultural markets are reasonably competitive, the data suggest that both quality and transportation cost factors account for the estimated geographical price differentials.

Grain crops and hay

An abundance of grain and hay is a primary factor in the geographical concentration of livestock production in the North Central Region. Moreover, with reference to projected increases in grain and hay crops, the North Central Region is expected to become even more important in 1975 than it was in 1955 (table 9). Sixty-two percent of the projected increase in wheat, 90 percent of the projected increase in corn and oats and 67 percent of the projected increase in hay are expected to occur in the North Central Region. These trends portend for this region an even greater emphasis on cattle feeding in the long run than in 1955 or even in 1975.

Miscellaneous items

In the case of most other crops, the North Central Region accounts for only a small percentage of the national production. However, a major part of the projected increase in the production of soybeans, flaxseed and dry edible beans is expected to occur in the region (table 10).

Regional Demand Estimates

Using the regional estimates of farm output and the procedure discussed with equation 5.9 and equations 7.1-7.4, regional estimates of final demand were prepared for the 18 agricultural sectors. Thus, the regression coefficient representing regional output as a function of national output is assumed to also represent a corresponding relationship in the case of final demand.

As pointed out in the discussion of equation 5.9, regional estimates of final demand for different agricultural outputs are not available; hence, the alternative approach has been offered as a means of estimating prospective changes in regional demands. The regional estimates that were derived are presented for the 18 sectors under the three major commodity groups used earlier.

Livestock and livestock products

Generally, the projected percentage change in the final demand for livestock and livestock products for the North Central States is somewhat smaller than it is for the United States (as shown by a comparison of the last columns in tables 6 and 11). On a sub-regional basis, however, the rate of growth in output may exceed the national rate (e.g., cattle and calves in the Western Corn Belt and hogs in the Northern Plains) even though the average regional rate of growth is below the national level.

For several commodities, the projected regional change is substantially above the corresponding change in national output. The final demand for turkeys, farm dairy products and wool, for example, is expected to increase more rapidly in the North Central Region than in the country as a whole.

Table 9. Prediction equations for specified grain crops and hay, and estimated changes in production, North Central states, 1955-75.^a

Item	Region and subregion	Regression coefficient r b (units)	Projected change in production (units)	Average farm price (\$)	Estimated value of change in production (\$1,000)
Wheat	North Central	0.6153	93,440	2.07	193,421
	N. Plains	0.5088	97,487	2.12	206,672
	W. Corn Belt	--	-8,365	2.03	-16,981
Rice	E. North Central	--	4,318	1.96	8,463
	North Central	0.0061	13	4.50	58
	W. Corn Belt	0.0061	13	4.50	58
Rye	North Central	0.6747	-767	1.02	-782
	N. Plains	0.6128	-252	1.04	-262
	W. Corn Belt	--	-157	1.01	-159
Buckwheat	E. North Central	--	-358	0.93	-333
	North Central	0.2588	194	--	194
	N. Plains	--	15	--	15
Corn	W. Corn Belt	--	45	--	45
	E. North Central	0.1777	134	--	134
	North Central	0.9034	1,108,466	1.38	1,529,683
Hay	N. Plains	--	178,103	1.39	247,563
	W. Corn Belt	0.3847	476,515	1.42	676,651
	E. North Central	0.3664	453,848	1.34	608,156
Oats	North Central	0.6734	22,876	19.40	443,794
	N. Plains	0.3022	12,745	19.23	245,086
	W. Corn Belt	0.2413	10,176	17.77	180,828
Barley	E. North Central	--	-45	20.79	-936
	North Central	0.8964	21,625	0.60	12,975
	N. Plains	--	44,863	0.58	26,021
Sorghum grain	W. Corn Belt	0.3618	-12,755	0.60	-7,653
	E. North Central	0.2974	-10,484	0.61	-6,395
	North Central	0.3544	111,796	0.92	102,852
Other crops	N. Plains	0.3184	122,048	0.90	109,843
	W. Corn Belt	--	-5,388	0.95	-5,119
	E. North Central	--	-4,864	0.94	-4,572
Other crops	North Central	0.5069	75,468	1.08	81,505
	N. Plains	0.4371	65,076	1.07	69,631
	W. Corn Belt	0.0651	9,692	1.12	10,855
	E. North Central	0.0047	700	1.20	840

a/ Units refer to those specified in table 7.

Table 10. Prediction equations for specified crops and estimated changes in production, North Central States, 1955-57.^a

Item	Region and subregion	Regression coefficient r b (units)	Projected change in production (mil. units)	Average farm price (\$)	Estimated value of change in production (\$1,000)
Cottonseed	North Central	0.0384	53	40.98	2,172
	W. Corn Belt	0.0384	53	40.99	2,172
Cotton production	North Central	0.0372	64,590	32.68	21,108
	W. Corn Belt	0.0372	64,590	32.68	21,108
Tobacco	North Central	--	22,106	--	22,106
	N. Plains	--	-78	--	-78
	W. Corn Belt	--	3,473	--	3,473
Tobacco products	E. North Central	--	18,711	--	18,711
	North Central	--	7,736	40.8	315,629
	N. Plains	--	-28	49.6	-1,389
Soybeans	W. Corn Belt	--	848	49.0	41,552
	E. North Central	--	6,916	40.1	277,332
	North Central	0.6939	121,771	2.22	270,332
Flaxseed	N. Plains	0.0430	7,546	2.08	15,696
	W. Corn Belt	0.3182	55,840	2.18	121,731
	E. North Central	0.3326	58,367	2.25	131,326
Dry edible peas	North Central	0.9437	7,283	2.84	20,683
	N. Plains	0.6566	5,644	2.82	15,916
	W. Corn Belt	--	1,563	2.89	4,517
Dry edible beans	E. North Central	--	76	2.77	211
	North Central	--	29	4.29	124
	N. Plains	--	24	4.17	100
Potatoes	W. Corn Belt	--	5	4.34	22
	North Central	0.7260	2,881	7.21	20,772
	N. Plains	0.0842	-235	6.54	-1,537
Sweetpotatoes	E. North Central	0.6414	3,116	7.39	23,027
	North Central	--	9,207	1.95	17,954
	N. Plains	--	4,141	1.88	7,785
Truck crops	W. Corn Belt	--	2,158	2.08	4,489
	E. North Central	--	2,908	1.92	5,583
	North Central	0.0234	89	4.40	392
Fruits	N. Plains	--	5	4.15	21
	W. Corn Belt	--	42	4.55	191
	E. North Central	--	42	--	--
Other crops	North Central	0.1981	140,143	--	140,143
	N. Plains	--	4,209	--	4,209
	W. Corn Belt	--	16,209	--	16,209
Other crops	E. North Central	0.1550	119,725	--	119,725
	North Central	0.0578	32,157	--	32,157
	N. Plains	--	906	--	906
Other crops	W. Corn Belt	--	3,098	--	3,098
	E. North Central	0.0585	28,152	--	28,152
	North Central	0.1650	73,441	--	73,441
	E. North Central	0.1220	54,302	--	54,302

a/ Units refer to those in table 7.

Table 11. Distribution of 1955 production of specified livestock and livestock products and estimated 1975 final demand, by subregion, North Central States.

Item	Region and subregion	Estimated 1955 production			Projected 1975 final demand	
		Total output	Intermediate demand	Final demand	Total	Proportion of 1955 final demand
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(percent)
1: Cattle and calves	North Central	3,498,803	1,148,830	2,349,973	3,674,878	156.4
	N. Plains	1,136,457	287,550	848,907	1,326,741	156.3
	W. Corn Belt	1,307,366	494,584	812,782	1,322,186	162.7
	E. North Central	1,054,980	366,696	688,284	1,025,951	149.1
Hogs	North Central	2,377,870	26,599	2,351,271	3,416,556	145.3
	N. Plains	323,193	5,342	317,851	559,916	176.2
	W. Corn Belt	1,100,720	14,273	1,086,447	1,558,412	143.4
	E. North Central	953,957	6,984	946,973	1,298,228	137.1
Sheep and lambs	North Central	158,380	58,100	100,280	155,236	154.8
	N. Plains	54,489	22,353	32,136	56,812	176.8
	W. Corn Belt	61,330	24,266	37,064	55,877	150.8
	E. North Central	42,561	11,481	31,080	42,547	136.9
2: Farm chickens	North Central	147,876	--	147,876	72,002	48.7
	N. Plains	25,523	--	25,523	11,918	46.7
	W. Corn Belt	51,036	--	51,036	27,143	53.2
	E. North Central	71,317	--	71,317	32,941	46.2
Broilers	North Central	90,446	--	90,446	144,872	160.2
	N. Plains	4,016	--	4,016	4,053	100.9
	W. Corn Belt	24,485	--	24,485	44,332	181.1
	E. North Central	61,945	--	61,945	96,487	155.8
Turkeys	North Central	134,828	--	134,828	341,000	252.9
	N. Plains	12,411	--	12,411	22,793	183.7
	W. Corn Belt	76,770	--	76,770	208,690	271.8
	E. North Central	45,647	--	45,647	109,517	239.9
Eggs	North Central	778,328	33,825	744,503	865,996	116.3
	N. Plains	131,155	3,773	127,382	165,425	129.9
	W. Corn Belt	299,821	12,519	287,302	322,111	112.1
	E. North Central	347,352	17,533	329,819	378,460	114.7
Other poultry	North Central	17,852	8,624	9,228	11,634	126.1
	N. Plains	2,760	1,064	1,696	2,055	121.2
	W. Corn Belt	6,977	4,480	2,497	3,438	137.7
	E. North Central	8,115	3,080	5,035	6,141	122.0
3: Farm Dairy Products	North Central	2,024,287	62,244	1,962,043	2,644,570	134.8
	N. Plains	211,384	7,866	203,518	193,450	95.1
	W. Corn Belt	556,358	14,882	541,476	795,010	146.8
	E. North Central	1,256,545	39,496	1,217,049	1,656,110	136.1
4: Other livestock	North Central	110,990	--	110,990	129,676	116.8
	N. Plains	14,370	--	14,370	22,572	157.1
	W. Corn Belt	29,442	--	29,442	34,988	118.8
	E. North Central	67,178	--	67,178	72,116	107.4
Wool	North Central	33,143	--	33,143	52,128	157.3
	N. Plains	10,582	--	10,582	19,112	180.6
	W. Corn Belt	10,330	--	10,330	15,910	154.0
	E. North Central	12,231	--	12,231	17,106	139.9
Mohair and other	North Central	58	--	58	58	100.0
	W. Corn Belt	58	--	58	58	100.0
Horses and mules	North Central	4,046	--	4,046	2,023	50.0
	N. Plains	987	--	987	494	50.1
	W. Corn Belt	1,410	--	1,410	705	50.0
	E. North Central	1,649	--	1,649	824	50.0
Honey	North Central	19,422	--	19,422	21,364	110.0
	N. Plains	1,796	--	1,796	1,976	110.0
	W. Corn Belt	7,292	--	7,292	8,021	110.0
	E. North Central	10,334	--	10,334	11,367	110.0
Beeswax	North Central	1,034	--	1,034	1,138	110.1
	N. Plains	105	--	105	116	110.5
	W. Corn Belt	423	--	423	465	109.9
	E. North Central	506	--	506	557	110.1
Miscellaneous	North Central	52,965	--	52,965	52,965	100.0
	N. Plains	874	--	874	874	100.0
	W. Corn Belt	9,829	--	9,829	9,829	100.0
	E. North Central	42,262	--	42,262	42,262	100.0

Because of the estimation procedures, the projected percentage increases in final demand may differ from projected percentage increases in output. As shown in table 8, a 1-unit change in national output of cattle and calves was associated with a 0.4796-unit change in output in the North Central States over the 1949-60 period. The two west North Central subregions were about equally responsive in total output, but, because of the lower level of intermediate demand in the Northern Plains, the change in residual or final demand is expected to be somewhat larger in the Northern Plains than in the Western Corn Belt. Other commodity categories are affected similarly so that the projected percentage in final demand will differ from the projected percentage change in gross output or total farm production of a particular commodity.

Grain crops and hay

The 1955 and 1975 regional data on grain crops and hay summarized in table 12 show substantial variability among the subregions in expected changes in final demand for individual commodities. Also, the projected percentage changes differ considerably from the corresponding changes in national production (see table 7). Again, farm production data for the 1949-60 period were used to estimate the prediction relationships (table 9).

It is quite possible that the projected changes in feed and forage supplies (table 12) are not consistent with the projected changes in meat-animal supplies (table 11). Since each commodity estimate is based on the relationship between regional and national production, a change in the level of exports or in feed conversion rates could affect the feed-livestock bal-

Table 12. Distribution of 1955 production of specified grain crops and forage, and estimated 1975 final demand, by subregion, North Central States.

Item	Region and subregion	Estimated 1955 production			Projected 1975 final demand		
		Total output (\$1,000)	Intermediate demand (\$1,000)	Final demand (\$1,000)	Total (\$1,000)	Proportion of 1955 final demand (percent)	
5: Wheat	North Central	1,182,939	111,923	1,071,016	1,244,018	116.2	
	N. Plains	737,964	62,129	675,835	832,858	123.2	
	W. Corn Belt	132,152	14,123	118,029	107,547	91.1	
	E. North Central	312,823	35,671	277,152	303,613	109.5	
			628	31	597	651	109.0
Rice	North Central	628	31	597	651	109.0	
	W. Corn Belt	628	31	597	651	109.0	
Rye	North Central	24,565	9,032	15,533	15,111	97.3	
	N. Plains	16,662	3,432	13,230	13,827	104.5	
	W. Corn Belt	3,065	1,458	1,607	1,222	76.0	
	E. North Central	4,838	4,142	696	61	8.8	
			695	414	281	281	100.0
Buckwheat	North Central	205	90	115	115	100.0	
	W. Corn Belt	490	324	166	166	100.0	
	E. North Central	490	324	166	166	100.0	
			3,364,490	2,313,045	1,051,445	1,616,624	153.8
	6: Corn	North Central	3,364,490	2,313,045	1,051,445	1,616,624	153.8
	N. Plains	341,708	378,750	-37,042	51,540	-139.1	
	W. Corn Belt	1,339,638	1,019,564	320,074	570,754	178.3	
	E. North Central	1,683,144	914,731	768,413	994,330	129.4	
Hay	North Central	1,117,673	1,034,688	82,985	122,688	147.8	
	N. Plains	328,208	327,697	511	17,356	3,396.5	
	W. Corn Belt	316,100	287,020	29,080	42,456	146.0	
	E. North Central	473,365	419,971	53,394	62,876	117.8	
			768,484	601,115	167,369	98,603	58.9
Oats	North Central	768,484	601,115	167,369	98,603	58.9	
	N. Plains	140,965	90,099	50,866	26,100	51.3	
	W. Corn Belt	307,842	258,735	49,107	39,792	81.0	
	E. North Central	319,677	252,281	67,396	32,711	48.5	
			151,027	51,067	99,960	178,568	178.6
Barley	North Central	151,027	51,067	99,960	178,568	178.6	
	N. Plains	96,912	31,987	64,925	148,958	229.4	
	W. Corn Belt	38,477	7,633	30,844	29,335	95.1	
	E. North Central	15,638	11,447	4,191	275	6.6	
			46,354	27,292	19,062	75,596	396.6
Sorghum grain	North Central	46,354	27,292	19,062	75,596	396.6	
	N. Plains	43,700	25,259	18,441	66,846	362.5	
	W. Corn Belt	2,612	2,032	580	8,124	1,400.7	
	E. North Central	42	1	41	626	1,526.8	

ance in the North Central States. To ascertain the degree of inconsistency, if any, that occurs between the two series of estimates, the regional input-output structures can be used along with the data for projected production and final demand. This procedure is followed later.

Miscellaneous items

The projected final demands for miscellaneous agricultural outputs of the North Central States are summarized in table 13. Because of the low production of many miscellaneous items, the regional regression coefficients (table 10) were less satisfactory for estimating final demands than in the case of meat animals and feed grains. Accordingly, more conservative projection rules were used which generally resulted in rather small intraregional or subregional differences in the percentage changes in final demand.

Final demands

Regional and subregional estimates of final demands for each of the 18 agricultural sectors are listed in tables 14 and 15. These estimates include intermediate or processing demands as well as final consumption and exports. The major sources of demand are not identified with respect to region; they may originate in the North Central States or entirely outside these states. Only the geographical sources of farm outputs are specified in the two tables.

When examining the summary estimates of final demand, the final use of the legume-and-grass-seeds sector for 1955 is observed to be negative for the North Central Region (thus indicating a deficit re-

gion for intermediate agricultural use). The legume-and-grass-seeds sector produces primarily for the agricultural sectors, with very little going to final-demand use. Therefore, the North Central Region is shown to consume more within the region than is produced; hence, it must import from other regions.

Likewise, the agricultural-services sector would have a deficit final demand for all other regions. The deficit is due to the transfer of chicks between the two major regions. As in sector 13, no increase in national final demand was projected because of the limited use of the commodities and services of the agricultural services sector.

ESTIMATION OF INTERSECTORAL TRANSACTIONS

The most time-consuming procedure in the input-output method is that of constructing the flow matrix. This also is the step upon which all further analyses are based. In this section, therefore, the production data used in preparing demand estimates are presented in terms of their use in fitting the input-output model.

Constructing the Flow Matrices

Two tables of regional data summarize several of the individual commodity estimates presented earlier. Table 16 shows the total value of production of meat animals as the sum of the commodities included in this sector for 1955 by regions. According to the data in this table, the North Central Region accounted for 63 percent of the total value of production of meat animals in 1955. In terms of the specific com-

Table 13. Distribution of 1955 production of other crops and services and estimated final demand, by subregion, North Central States.

Item	Region and subregion	Estimated 1955 production			Projected 1975 final demand	
		Total output	Intermediate demand	Final demand	Total	Proportion of 1955 final demand
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(percent)
7: Cottonseed	North Central	6,872	361	6,511	8,643	132.7
	W. Corn Belt	6,846	361	6,485	8,617	132.9
	E. North Central	26	0	26	26	100.0
Cotton Prod.	North Central	67,295	--	67,295	88,421	131.4
	W. Corn Belt	67,010	--	67,010	88,136	131.5
	E. North Central	285	--	285	285	100.0
8: Tobacco	North Central	23,117	10	23,107	26,991	116.8
	N. Plains	57	--	57	41	71.9
	W. Corn Belt	2,000	1	1,999	2,472	123.7
	E. North Central	21,060	9	21,051	24,478	116.3
9: Soybeans	North Central	682,490	46,880	636,610	888,185	139.5
	N. Plains	19,557	2,349	17,208	31,864	185.2
	W. Corn Belt	266,753	20,852	245,901	359,902	146.4
	E. North Central	397,180	23,679	373,501	496,419	132.9
Flaxseed	North Central	109,595	10,881	98,714	117,413	118.9
	N. Plains	85,708	8,132	77,576	92,203	118.9
	W. Corn Belt	23,715	2,729	20,986	24,883	118.6
	E. North Central	172	20	152	327	215.1
10: Dry edible peas	North Central	253	37	216	359	166.2
	N. Plains	75	14	61	178	291.8
	W. Corn Belt	178	23	155	181	116.8
Dry edible beans	North Central	42,661	1,970	40,691	60,907	149.7
	N. Plains	8,151	260	7,891	10,005	126.8
	E. North Central	34,510	1,710	32,800	50,902	155.2
Potatoes	North Central	74,438	15,008	59,430	70,440	118.5
	N. Plains	21,717	4,517	17,200	22,970	133.5
	W. Corn Belt	19,605	3,911	15,694	17,716	112.9
	E. North Central	33,116	6,580	26,536	29,754	112.1
Sweetpotatoes	North Central	757	67	690	1,011	146.5
	N. Plains	257	24	233	281	120.6
	W. Corn Belt	500	43	457	730	159.7
Truck crops	North Central	303,995	--	303,995	444,135	146.1
	N. Plains	25,558	--	25,558	30,216	118.2
	W. Corn Belt	79,069	--	79,069	104,914	132.7
	E. North Central	199,368	--	199,368	309,005	155.0
11: Fruits	North Central	82,404	--	82,404	111,394	135.2
	N. Plains	1,065	--	1,065	2,014	189.1
	W. Corn Belt	4,315	--	4,315	7,523	174.3
	E. North Central	77,024	--	77,024	101,857	132.2
13: Legume and grass seeds	North Central	55,210	53,220	1,990	-8,107	-407.4
	N. Plains	16,274	15,687	587	279	47.5
	W. Corn Belt	20,790	20,041	749	632	84.4
	E. North Central	18,146	17,492	654	-9,018	-1,378.9
14: Sugar and sirup	North Central	38,036	398	37,638	52,036	138.3
	N. Plains	13,818	154	13,664	18,891	138.2
	W. Corn Belt	9,721	96	9,625	13,307	138.3
	E. North Central	14,497	148	14,349	19,838	138.3
15: Miscellaneous crops	North Central	12,350	161	12,189	12,950	106.2
	N. Plains	619	10	609	696	114.3
	W. Corn Belt	1,557	22	1,535	1,646	107.2
	E. North Central	10,174	129	10,045	10,608	105.6
16: Forest products	North Central	60,112	-61,773	121,885	141,209	115.9
	N. Plains	2,834	-2,883	5,717	7,935	138.8
	W. Corn Belt	19,534	-20,064	39,598	42,416	107.1
	E. North Central	37,744	-38,826	76,570	90,859	118.7
17: Greenhouse and nursery	North Central	188,139	29,837	158,302	178,764	112.9
	N. Plains	9,556	1,837	7,719	10,067	130.4
	W. Corn Belt	35,645	5,843	29,802	32,786	110.0
	E. North Central	142,938	22,157	120,781	135,911	112.5
18: Ag. services	North Central	372,978	339,659	33,319	33,319	100.0
	N. Plains	80,315	79,366	949	949	100.0
	W. Corn Belt	124,589	107,619	16,970	16,970	100.0
	E. North Central	168,074	152,674	15,400	15,400	100.0

Table 14. Estimated final demand for specified agricultural outputs in constant 1955 dollars, United States and North Central Region, 1955 and 1975.

Sector	United States		North Central	
	1955	1975	1955	1975
	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
1	7,733,139	11,951,452	4,810,535	7,251,948
2	3,299,231	5,294,379	1,126,881	1,435,502
3	4,661,659	6,671,350	1,962,043	2,644,570
4	304,020	351,161	110,668	129,676
5	1,977,406	2,261,642	1,087,427	1,260,061
6	1,839,759	2,752,212	1,420,825	2,092,080
7	2,619,342	3,239,882	73,806	97,064
8	1,150,851	1,411,339	23,107	26,991
9	1,037,311	1,471,519	734,874	1,005,598
10	2,173,251	2,975,753	405,018	576,852
11	1,239,455	1,740,838	82,404	111,394
12	128,137	183,112	--	--
13	27,043	27,043	-8,107	-8,107
14	202,358	289,647	37,638	52,036
15	46,108	50,719	12,189	12,950
16	468,607	585,759	121,885	141,209
17	496,176	620,220	158,302	178,763
18	2,865	2,865	33,319	33,319

Table 15. Estimated final demand for specified agricultural outputs, in constant 1955 dollars, by subregions of the North Central Region, 1955 and 1975.

Sector	Northern Plains		Western Corn Belt		East North Central	
	1955	1975	1955	1975	1955	1975
	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
1	1,201,369	1,946,207	1,939,305	2,937,222	1,669,861	2,368,519
2	171,028	206,244	442,096	605,714	513,763	623,546
3	203,518	193,450	541,476	795,010	1,217,049	1,656,110
4	14,344	22,572	29,342	34,988	66,982	72,116
5	689,055	846,685	120,348	109,535	278,014	303,840
6	97,703	310,800	429,687	690,461	893,435	1,090,818
7	--	--	73,495	96,753	311	311
8	57	41	1,999	2,472	21,051	24,478
9	94,784	124,067	266,887	384,785	373,203	496,746
10	50,943	63,650	95,371	123,541	258,704	389,661
11	1,065	2,014	4,315	7,523	77,024	101,857
12	--	--	--	--	--	--
13	279	279	632	632	-9,018	-9,018
14	13,664	18,891	9,625	13,307	14,349	19,838
15	609	696	1,535	1,646	10,045	10,608
16	5,717	7,935	39,598	42,416	76,570	90,859
17	7,719	10,067	29,802	32,786	120,781	135,911
18	949	949	16,970	16,970	15,400	15,400

Table 16. Total value of production of meat-animals sector, by region, 1955.

Commodity	Continental United States (\$1,000)	North Central Region (\$1,000)	Northern Plains (\$1,000)	Western Corn Belt (\$1,000)	East North Central (\$1,000)
Cattle and calves	6,221,612	3,498,803	1,136,457	1,307,366	1,054,980
Hogs	3,051,245	2,377,870	323,193	1,100,720	953,957
Sheep and lambs	366,542	158,380	54,489	61,330	42,561
Goats	2,685	51	51	51	51
Hides	20,567	8,359	2,272	2,767	3,320
Manure	1,359	601	203	194	204
Total	9,664,010	6,044,064	1,516,614	2,472,428	2,055,022

Table 17. Total value of production of the agricultural sectors, by regions, 1955.

Input-output sector	Continental United States (\$1,000)	North Central Region (\$1,000)	Northern Plains (\$1,000)	Western Corn Belt (\$1,000)	East North Central (\$1,000)
1	9,664,010	6,044,064	1,516,614	2,472,428	2,055,022
2	3,477,711	1,169,330	175,865	459,089	534,376
3	4,789,679	2,024,287	211,384	556,358	1,256,545
4	305,027	110,990	14,370	29,442	67,178
5	2,205,173	1,208,827	754,626	136,050	318,151
6	8,464,175	5,448,028	951,493	2,004,669	2,491,866
7	2,631,291	74,167	—	73,856	311
8	1,151,342	23,117	57	2,000	21,060
9	1,122,125	793,085	105,265	290,468	397,352
10	2,258,960	422,104	55,758	99,352	266,994
11	1,239,455	82,404	1,065	4,315	77,024
12	128,137	—	—	—	—
13	170,582	55,210	16,274	20,790	18,146
14	206,620	38,036	13,818	9,721	14,497
15	50,569	12,350	619	1,557	10,174
16	468,607	121,885	5,717	39,598	76,570
17	630,372	188,139	9,556	35,645	142,938
18	1,128,926	372,978	80,315	124,589	168,074

modities and in dollar value, 56 percent of the cattle and calves, 78 percent of the hogs and 43 percent of the sheep and lambs were produced in the North Central Region. Finally, in table 17, the total 1955 value of regional production for all agricultural sectors is summarized for each of the 18 agricultural sectors.

Sectoral and regional allocation of inputs

As mentioned earlier, full use was made of the Masucci report (17) for the allocation of inputs, both sectorally and regionally. With only a few exceptions (mentioned later), the specified data are being used in this report for the national model and are then disaggregated for the regional analysis.

Agricultural factor inputs. The most detailed estimation of factor inputs took place in the agricultural interdependence model. For certain sectors, agriculture is the major purchaser of other agricultural products. As an example of this relationship, the meat-animals sector is the major purchasing agent from the feed-crop sector.

For the regional estimation of the agricultural interdependence model, Masucci's national data were disaggregated by region. However, one alternation was made in Masucci's data. Animal work-power, which consists of work performed by horses and mules on farms, was shown to consume 10 percent of the total output of the feed-crops sector in 1955. Using other data from the United States Department of

Agriculture (9), this estimate appears much too high. Computing a new quantity according to amount of feed fed to horses and mules on farms in 1955, an estimate of 3.4 percent was shown to be more realistic. Hence, a new estimate was used in allocating feed inputs to the various sectors.

Earlier, a discussion was presented on regional differentiation of technical structure where the regional input-output coefficient was depicted as some function of the national input-output coefficient. This relationship can be of the form,

$$a_{ij}^r = b_{ij}^r a_{ij}, \tag{8.1}$$

with all quantities defined as before and with b_{ij}^r indicating the relation between the regional and national coefficient. Decomposing the terms, as was done in equation 5.5, we have,

$$\frac{p_{ij}^r x_{ij}^r}{p_j^r x_j^r} = b_{ij}^r \left[\frac{p_{ij} x_{ij}}{p_j x_j} \right] \tag{8.2}$$

Two elements of equation 8.2 are selected and analyzed for expected deviations of b^r from unity. The first element is the price ratio,

$$\frac{p_{ij}^r}{p_j^r} = b_{ij}^{r*} \left[\frac{p_{ij}}{p_j} \right] \tag{8.3}$$

Equation 8.3 signifies that the price ratio between inputs and outputs may be different for a region as compared with the nation. These differences include (a) quality differences in inputs or outputs demanding higher or lower prices, (b) transportation costs between excess and deficit regions and (c) market imperfections resulting in price discrepancies from that of perfect competition. The value of b_{ij}^{r*} in equation 8.3 may be evaluated quite easily because of adequate data on prices by regions, especially in the agricultural segment.

The second element causing differences in the regional and national coefficients is the physical relation between inputs and outputs in the expression,

$$\frac{x_{ij}^r}{x_j^r} = b_{ij}^{r**} \left[\frac{x_{ij}}{x_j} \right] \tag{8.4}$$

Equation 8.4 denotes the quantity of input necessary for a unit of output which may be different from the region as compared with the nation and may be measured by b_{ij}^{r**} . These differences include (a) quality of the inputs affecting quantity outputs, (b) efficiency of production due to organization, (c) climatical conditions affecting production and (d) relative importance of inputs for certain regions

(which may not be due to inefficiencies but merely to the locational attributes of the input). The b_{ij}^{r**} value of equation 8.4 is more difficult to estimate than the b_{ij}^{r*} value of equation 8.3, because input data are not available by states or regions except for select years.

One of the problems for the present study was that of estimating feed inputs for the livestock sectors by regions. Detailed data are available for national estimates of feed inputs by species of livestock and types of feed inputs by years. However, these are not broken down by states or regions. There are extensive data for 1949-50 given by Jennings (9) for state allocations of feed inputs to the livestock species, but these data do not extend to 1955. Nonetheless, the b_{ij}^r values were estimated from these data and analyzed for any changes that had occurred during the interim.

Another problem in estimating the inputs of the agricultural interdependence model pertained to factor input valuation. Two approaches could have been used. One method would be to value the agricultural input at regular market price or what is termed as the average price received by the farmer. The other method would be to compute some imputed price for the commodity. The first of the two methods was used in this analysis. However, the use of average prices received by farmers has certain drawbacks in that it tends to overvalue inputs such as feed crops that are used by the livestock sector. In other words, a farmer may realize more profit as a firm by feeding the grain to livestock than by selling his grain on the open market. The enterprise as a whole will show more profit, but, by valuing the grain at market price, a higher profit will be shown in the feed-crop sector relative to the livestock sector. The alternative of imputing a price to feed crops used on the farm where grown was beyond the scope of this project; hence, the market price was used.

Agricultural inputs so far have been valued only at producers' value. However, agricultural inputs not produced on the farm also have a purchasers' value, and the difference between the two is allocated to the so-called margin industries. This will be discussed more fully under allocation of industry and primary factor inputs.

Industry and primary factor inputs. To complete the production function, nonagricultural inputs from the industrial and primary sectors must be estimated. The row sector classification has been given in the previous section by sector description and by industries covered by the Standard Industrial Classification (21).

Agricultural expenditures for manufacturing goods and services were first classified into broad categories by type of expenditure. The Masucci report (17) has the following broad classification of expenditures in the explanatory notes to input tables: Veterinary

services, drugs and medicines, professional services; pesticides, insecticides, fungicides, chemicals and chemical products; binding materials; irrigation; miscellaneous dairy supplies; miscellaneous livestock marketing charges; telephone; electric light and power; miscellaneous farm business expenses; miscellaneous expenses of greenhouse and nursery; containers; miscellaneous hardwares; fertilizer and lime; farm nonresidential rents; repair and operation of motor vehicles; and maintenance and construction. The primary factors of production were also classified by type of expenditure, whether federal government, state and local government, or households. Each broad category of expenditures is composed of a number of specific inputs. For example, the category of fertilizer and lime is composed of individual inputs, such as crushed and broken limestone, phosphate rock, inorganic chemicals, potash, soda, borate minerals, fertilizer minerals and lime.

Once inputs were specified for agriculture as a whole, the next problem was that of allocation among specific agricultural sectors. Although input data are generally unavailable for specific agricultural sectors, the Masucci report (17) provided a basis for distributing many inputs or expenses of production by type of farm reported in (43). In general, input allocations were made by first distributing the estimated total for each specific item of expense for all of agriculture as estimated by the Farm Production Expenditure Unit, Farm Income Branch, and by type of farm or other sources on the basis of the distribution shown in (43). These type-of-farm distributions of each input or expense were then allocated to specific agricultural sectors on the basis of the distribution of sales, the value of production of specific commodities or both by type of farm. In short, the following pattern of transformation was used in deriving specific sector input estimates: (a) specific expense for all of agriculture to (b) specific expense by type of farm to (c) specific expense, by type of farm, allocated to specific commodities for each type to (d) specific expense allocated to specific commodities on commodity groups, which are obtained as the summation of the allocations to each commodity or commodity group mentioned in (c).

The classification of inputs by industry and then by specific agricultural input sectors was extremely useful in terms of the regional allocation of inputs to agriculture. The first step in the disaggregation of national inputs to regional inputs was in the state allocation of agricultural expenditures.

In the next stage of data preparation, the expenditures were disaggregated according to region. A further step was to allocate the regional expenditures according to sector use within the region. A first approximation of regional use within a sector was obtained by allocating the national sector use to the regions by value of production of that sector. After allocation among all sectors had taken place, a sum-

mation was computed across all sectors to obtain the regional expenditure. However, this computed regional expenditure probably would not be the same as the regional expenditure obtained from (43). Therefore, regional sector use was decreased or increased proportionally to agree with the survey estimate. An iterative process was used to obtain a unique estimate for each sector by region, with the constraint that the expenditure must add to the national expenditure within the sector and that the expenditure must sum across sectors within a region to obtain the total regional expenditure obtained through survey data.

Much of the basic data dealing with industrial inputs for agriculture were in terms of purchasers' values; that is, what farmers paid for them. If the expenditure is a service, such as utilities or repair services, the producers' and purchasers' values are the same. When the initial expenditures were in purchasers' value, the allocation was carried out in that form and then converted to producers' value on the basis of the ratio of producers' to purchasers' value shown in the 1947 Bureau of Labor Statistics Inter-industry Study (6). The difference between producers' and purchasers' value is allocated to the margin industries which are composed of the retail and wholesale industries as well as of certain transportation and other miscellaneous sectors.

Finally, labor expenditures, which are reported by states, were allocated to the various sectors by the same procedure as used in allocating other farm expenditures. Depreciation of capital items—such as farm machinery, tools and buildings—was computed according to value of such items or, as in the case of vehicles, by number reported in each state. Short-term and farm-mortgage interest also were allocated by sectors and regions.

Farm proprietors' income was computed as a residual. It constitutes the difference existing after all expenditures have been subtracted from the total value of output of a sector. In the short run, with fixed capital assets and where capital depreciation is included as an expense, farm proprietors' income may show a loss for any particular sector. However, since most farm units include several enterprises (sectors in this case), a profit may exist for the farm unit as a whole, while any one enterprise may incur a loss.

Empirical results

Each of the completed flow matrices, presented now in tabular form, represents the flow of goods into and out of agricultural sectors by industry of origin and destination for 1955. The tabular material is summarized for the North Central Region and each of its subregions.

The entries in each row of intersectoral transactions table for the North Central Region (table 18) show in producers' value the dollar amount purchased from the sector at the right by the sector at the top.

For example, the meat-animals sector disposed of \$1,233,529,000 worth of products to itself as intrasector flows consisting mainly of feeder livestock. The meat-animals sector sold no other products to agricultural sectors. The feed-crops sector, however, disposed of \$2,446,464,000 worth of products to the meat-animals sector, \$259,295,000 to the poultry-and-eggs sector, \$1,197,743,000 to the farm-dairy-products sector, \$10,823,000 to the other-livestock-and-products sector—for a total of \$3,914,325,000 worth of products to the livestock sectors. Continuing across the row, the feed-crops sector sold products to most other crop sectors as an indirect input through animal workpower. In addition, the feed-crops sector sold to itself as an intrasector flow in the form of seed inputs.

The lower part of table 18 shows the flows from the manufacturing or service sectors to the agricultural sectors. However, for purposes of this report, the lower part of table 18 has been consolidated.

Tables 19, 20 and 21 show the intersectoral flows for the three subregions in the North Central States. Row entries have the same meaning as in the regional matrix.

Each column of table 18 presents a sector's input structure. The entries in each column represent the purchases of that sector from all other sectors. Using column 1 of table 18 as an illustration, it is shown that the meat-animals sector procured goods and services from itself and from the farm-dairy-products sector, the food-crops sector, the feed-crops sector, the oil-bearing-crops sector, the vegetables sector and the legume-and-grass-seeds sector in the agricultural segment. Purchases from the meat-animals and feed-crops sectors have been explained previously. Purchase or acquisition of \$62,244,000 worth of products from the farm-dairy-products sector represents milk fed to calves. The small quantities purchased from the other sectors (food-crops, oil-bearing crops, vegetables and legume and grass seeds) represent products grown and fed on farms where grown.

Major purchases from the manufacturing sectors by the meat-animals sector include \$206,693,000 worth of products from the food and kindred products sector, which is mainly prepared animal feeds. Other product acquisitions by the meat-animal sector include: \$94,568,000 worth of chemical products, mainly oil-seed meal products; \$274,358,000 from margin industries, which are retail and wholesale markups; \$123,323,000 from farm nonresidential rents, which refers to transactions relating to the farm rental services on buildings and land; \$51,586,000 from the construction sector, which includes outlays for soil and water conservation facilities, roads, irrigation facilities and maintenance of buildings. Altogether, \$923,633,000 worth of manufactured goods and services were acquired by the meat-animals sector (table 22). Other inputs are purchased from the primary factor sectors. Similarly, the purchases of the agri-

cultural sectors in the three subregions are represented in tables 19 to 22.

The relative magnitudes of the flows from industry into agriculture for the various regions, represented in tables 22 through 29, may be of great importance because of the effect on location of new and existing plants of the industry sectors. As an illustration, the manufacturing sectors sold \$157,471,000 worth of products to the livestock sectors in the Northern Plains (total of columns 1-4 in table 24), \$404,125,000 worth of products to the livestock sectors in the Western Corn Belt (table 26) and \$422,220,000 worth of products to the livestock sectors in the East North Central subregion (table 28). These quantities may be compared with the actual sales occurring in these regions in 1955 to evaluate new plant locations. In this way, the needs for some future date can be anticipated and plans can be made accordingly. This procedure will be analyzed more fully in the following section.

One additional entry in table 25 needs an explanation. The farm-dairy-products sector, column 3, shows a negative \$1,902,000 as total primary inputs for this sector — largely the result of proprietary income losses. As explained earlier, a sector may show negative proprietors' income in the short run. Several reasons may be given for negative returns to the farm-dairy sector of this region. Dairying is unimportant in the Northern Plains, and it does not constitute a major enterprise on the average farm. Since the typical farm combines several enterprises, any one enterprise, in this case dairying, may show negative returns. Additional analysis of this sector showed that, relative to other subregions in the North Central Region, the Northern Plains was not necessarily less efficient in dairy production in terms of feed required to produce a hundred pounds of milk. However, the price received by farmers per hundred pounds of milk sold was different for this subregion compared with the other subregions (see table 8). Milk prices were low in 1955 compared with other years, but the price in the Northern Plains was even lower than in the other regions. One reason for this may be difference in market organization in this region; for example, very little "grade A" milk is sold in this region.

The Direct Requirements Matrix

Method of construction

A technical coefficient matrix was constructed for each flow matrix described previously. A basic assumption of input-output is that a linear relationship exists between any endogenous input and the corresponding output. This assumption, however, need not apply to primary resource inputs.

The method of construction merely entails dividing each entry or input of a sector column by its corresponding gross domestic outlay or production. The data may be shown then as either dollar inputs per

dollar of output or amount of input per million dollars of output.

Empirical results

The direct requirements matrices appear in tables 30 through 33 which correspond to the flow matrices. These tables show the direct purchases of each sector from every other sector per million dollars of output in 1955. Using table 30 as an illustration, the meat-animals sector in the North Central Region, column 1, requires the following amount of goods and services from the agricultural sectors per million dollars of output: \$204,089 from the meat-animals sector, \$10,298 from the farm-dairy-products sector, \$1,162 from the food-crops sector, \$404,771 from the feed-crops sector, \$348 from the oil-bearing-crops sector, \$1,057 from the vegetables sector and \$1,390 from the legume-and-grass-seeds sector.

Other column sectors have similar interpretations. Each column sector then is interpreted as a production function requiring specific inputs for the production of a given level of output. The coefficient matrix is used in the following section when projected needs of the agricultural sectors are analyzed.

Subregional coefficient matrices are compared as to input structures for the production of various agricultural sectors. In the Northern Plains, for example, \$391,251 of feed-crop inputs are required to produce \$1,000,000 of meat-animals (table 31); whereas, in the Western Corn Belt, it takes \$428,207 (table 32). This does not mean that farming in the Northern Plains is inefficient compared with that in the Western Corn Belt; it means only that the input structure of meat-animal production differs. The poultry-and-eggs sector also differs in the amount of feed crops fed per unit of output for the two subregions; \$305,200 compared with \$240,082 for the Northern Plains and the Western Corn Belt, respectively. Further, the amount of input required from the manufacturing sectors by all the crop sectors differs for the three subregions.

Market Disbursement Matrix

The market disbursements from agriculture are given by Masucci (17). Hence, a market-disbursements matrix is not presented here since it can be obtained from that report. Moreover, no regional flows were estimated in this study since only a potential market analysis was undertaken.

The agricultural output represented in the disbursements matrix includes the total amount of the product available rather than the amount produced in 1955. It includes, therefore, any inventories available at the beginning of the period and any imported products from other countries. Wool, a major commodity of this sector comes both from national production and large import stocks. Therefore, the quantity of wool sold to the textile-mill-products sector is larger than the total domestic production.

The Inverse Matrices: Direct and Indirect Requirements

The interdependence matrices appear in tables 34 through 37. Using table 34 for the North Central Region as an illustration, delivery per \$1,000,000 of meat animals to intermediate processing and final-demand sectors required an increase in output of \$1,256,422 internally, \$1,202 from poultry and eggs, \$12,939 from farm-dairy products, \$1,603 from food crops, \$526,654 from feed crops, \$471 from oil-bearing crops, \$1,363 from vegetables, \$6,587 from legume and grass seeds, \$28 from greenhouse and nursery products and \$10,798 from agricultural services.

Subregional requirements may be illustrated by the Northern Plains (table 35), where delivery of \$1,000,000 of farm-dairy products to intermediate processing and final-demand sectors require an increase in output of \$1,557 from poultry and eggs, \$62 from food crops, \$855,091 from feed crops, \$11,565 from legume and grass seeds, \$27,157 dollars from agricultural services, as well as the \$1,000,000 delivery from the farm-dairy-products sector.

USE OF DATA IN PREDICTION AND ANALYSIS

Limiting assumptions must be made when using the input-output procedure for purposes of prediction. Final-demand predictions must be assumed to be of the same "mix" within any sector as during the base period. Even though sectors are disaggregated for predicting individual final demands (because of the assumption of constant coefficients of production), the aggregated quantity must act as a unit. For agricultural commodities, this may not be an especially severe limiting assumption because of similarity of inputs for production.

The most limiting assumption is that of fixed coefficients of production. In other words, the input structure for the predicted period must be the same as that for the base period. Technological change is ignored in the closed portion of the model. However, this is not a limiting factor for exogenous variables, such as primary resource inputs.

Direct and Indirect Demand Requirements From the Agricultural Sectors

One of the objectives of this study was to determine the requirements from agriculture to meet a projected final demand for 1975. Using the regional final-demand projections of tables 14 and 15 and the corresponding inverse matrices as given in tables 34-37, an estimate of direct and indirect requirements from agriculture by 1975 is given in tables 38 and 39 by sectors.

First, the total derived 1975 requirement from the meat-animals sector for the United States is given in table 38. For the same year, the total requirement from the North Central Region is \$9,111,507,000, while, from all other regions, the total requirement is \$5,820,820,000. On the subregional level, the total

derived requirements from the meat-animals sector by 1975 are as follows: \$2,456,901,000 in the Northern Plains, \$3,744,676,000 in the Western Corn Belt and \$2,914,827,000 in the East North Central States (table 39). The subregion totals do not add up exactly to the North Central Region requirements, and, likewise, the North Central Region and the all other regions total do not add up exactly to the United States total. Even though the regional final-demand estimates add to the total when applied to the inverse matrices, the differential effects of the regional interdependence coefficients will prevent the regional total requirements from adding to the United States total. Another factor, of course, is the occurrence of rounding errors.

One additional comment may be made concerning the predicted total requirements: It concerns the assumption of linearity and stability. The limitation of this assumption has been explained previously, but it has not been linked to actual estimates. The constant coefficients assumption implies no changes in the level of technology that existed in the base year, 1955. Wherever applicable, *a priori* information may be used to revise the estimates generated by the model. One case may be in the estimates of total feed crops required by 1975. One assumption is that livestock efficiency in feed utilization will increase by 10 percent over the base year by 1975 (19). Therefore, applying the 10-percent increase in livestock feed efficiency to the direct requirements from the feed-crops sector of \$9,948,100,000 (see ref. 17), a savings of \$994,810,000 is obtained for the United States as a whole. Decreasing the total direct and indirect requirements of feed crops by \$994,800,000 will leave \$11,706,000,000 as a revised estimate of total requirements from the feed-crop sector by 1975.

Direct Demand Requirements From Nonagricultural Sectors

The effect on industries furnishing factor inputs to agriculture of a change in total agriculture output is traced through the direct requirements matrices. In a predictive sense, total requirements from agriculture in 1975, given in tables 40 and 41, are multiplied by the technical or input-output coefficient matrix to determine the requirements from the industrial sectors in 1975.

Table 40 gives the requirements from each manufacturing and service sector by region to produce the predicted agricultural output of that region in 1975. This does not mean that the production of the industrial goods must take place in the designated region, but it does mean that the agricultural demand for the industrial goods originates in that region. The analysis may be used, therefore, to determine where potential market areas are located for specific goods as a basis for plant location.

To illustrate, the requirements from the food and kindred products sector to meet the total agricultural

Table 18. Estimated total inputs of specified agricultural sectors in the North Central Region and the sectoral origin of the inputs, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other livestock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
1	Meat animals	1,233,529								
2	Poultry and eggs		966							
3	Farm dairy products	62,244								
4	Other livestock and products				322					
5	Food crops	7,026	28,091			86,283				
6	Feed crops	2,446,464	259,295	1,197,743	10,823	3,746	104,782	397	96	2,356
7	Cotton							361		
8	Tobacco								10	
9	Oil-bearing crops	2,106								56,105
10	Vegetables	6,389								
11	Fruits									
13	Legume and grass seeds	8,404	57	2,820	4	2,290	35,479	142	53	1,697
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									
18	Agricultural services		82,744	22,191		64,014	101,125	8,826	825	39,840
	Total agriculture	3,766,162	371,153	1,222,754	11,149	156,333	241,386	9,726	984	99,998
	Total manufacturing and services	923,633	627,135	349,709	8,065	487,066	1,988,989	25,793	7,750	249,658
	Total primary inputs	1,354,269	171,042	451,824	91,776	565,428	3,217,653	38,648	14,383	443,429
	Gross domestic outlays	6,044,064	1,169,330	2,024,287	110,990	1,208,827	5,448,028	74,167	23,117	793,085

TABLE 18. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
1	Meat animals									1,233,529
2	Poultry and eggs									42,449
3	Farm dairy products								41,483	62,244
4	Other livestock and products									322
5	Food crops									121,400
6	Feed crops	615	54	262	147	12	127	284		4,027,203
7	Cotton									361
8	Tobacco									10
9	Oil-bearing crops									58,211
10	Vegetables	10,697								17,086
11	Fruits									
13	Legume and grass seeds	656	1	11,622	82		3	7		63,317
14	Sugar and sirup crops				398					398
15	Miscellaneous crops					161				161
16	Forest products									
17	Greenhouse and nursery products	7,867	1,415				1,278	19,277		29,837
18	Agricultural services	8,092	1,189	5,533	1,908	100	2,407	865		339,659
	Total agriculture	27,927	2,659	17,417	2,535	273	3,815	20,433	41,483	5,996,187
	Total manufacturing and services	91,487	17,249	17,155	13,778	2,423	5,388	33,914	119,397	4,968,589
	Total primary inputs	302,690	62,496	20,638	21,723	9,654	112,682	133,792	212,098	7,224,225
	Gross domestic outlays	422,104	82,404	55,210	38,036	12,350	121,885	188,139	372,978	18,189,001

Table 19. Estimated total inputs of specified agricultural sectors in the Northern Plains and the sectoral origin of the inputs, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other live-stock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)	Vegetables 10 (\$1,000)
1	Meat animals	315,245								
2	Poultry and eggs		239							
3	Farm dairy products	7,866								
4	Other livestock and products				26					
5	Food crops	1,625	6,497			57,449				
6	Feed crops	593,377	53,674	176,016	3,173	2,490	24,339	1	471	89
8	Tobacco									
9	Oil-bearing crops	157							10,324	
10	Vegetables	1,822								2,993
11	Fruits									
13	Legume and grass seeds	2,114	9	294		1,429	9,481		225	86
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									662
18	Agricultural services		11,585	2,173		39,600	17,386	2	5,198	1,046
	Total agriculture	922,206	72,004	178,483	3,199	100,968	51,206	3	16,218	4,876
	Total manufacturing and services	226,124	79,988	34,803	1,121	296,204	347,999	12	37,520	11,317
	Total primary inputs	368,284	23,873	-1,902	10,050	357,454	552,288	42	51,527	39,565
	Gross domestic outlays	1,516,614	175,865	211,384	14,370	754,626	951,493	57	105,265	55,758

TABLE 19. (continued)

Sector number	Item	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
1	Meat animals								315,245
2	Poultry and eggs							4,598	4,837
3	Farm dairy products								7,866
4	Other livestock and products								26
5	Food crops								65,571
6	Feed crops	1	82	54	1	6	16		853,790
8	Tobacco								
9	Oil-bearing crops								10,481
10	Vegetables								4,815
11	Fruits								
13	Legume and grass seeds		2,327	30					15,995
14	Sugar and sirup crops			154					154
15	Miscellaneous crops				10				10
16	Forest products								
17	Greenhouse and nursery products	18				177	980		1,837
18	Agricultural services	14	1,614	590	5	110	43		79,366
	Total agriculture	33	4,023	828	16	293	1,039	4,598	1,359,993
	Total manufacturing and services	217	5,173	4,860	112	299	1,818	27,587	1,075,154
	Total primary inputs	815	7,978	8,130	491	5,125	6,699	48,130	1,477,649
	Gross domestic outlays	1,065	16,274	13,818	619	5,717	9,556	80,315	3,912,796

Table 20. Estimated total inputs of specified agricultural sectors in the Western Corn Belt and the sectoral origin of the inputs, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other livestock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
1	Meat animals	533,123								
2	Poultry and eggs		296							
3	Farm dairy products	14,882								
4	Other livestock and products				100					
5	Food crops	1,472	5,886			8,344				
6	Feed crops	1,058,710	110,219	362,379	2,760	543	38,601	396	12	992
7	Cotton						361			
8	Tobacco								1	
9	Oil-bearing crops	903								22,678
10	Vegetables	1,506								
11	Fruits									
13	Legume and grass seeds	3,434	22	776	1	258	10,704	141	4	622
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									
18	Agricultural services		29,322	5,722		7,140	36,630	8,790	69	14,344
	Total agriculture	1,614,030	145,745	368,877	2,861	16,285	85,935	9,688	86	38,636
	Total manufacturing and services	378,613	259,700	117,248	2,209	54,542	684,216	25,681	645	87,971
	Total primary inputs	479,785	53,644	70,233	24,372	65,223	1,234,518	38,487	1,269	163,861
	Gross domestic outlays	2,472,428	459,089	556,358	29,442	136,050	2,004,669	73,856	2,000	290,468

TABLE 20. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
1	Meat animals									533,123
2	Poultry and eggs								16,703	16,999
3	Farm dairy products									14,882
4	Other livestock and products									100
5	Food crops									15,702
6	Feed crops	134	3	103	33	2	41	54		1,574,982
7	Cotton									361
8	Tobacco									1
9	Oil-bearing crops									23,581
10	Vegetables	2,475								3,981
11	Fruits									
13	Legume and grass seeds	154		4,019	20		1	2		20,158
14	Sugar and sirup crops				96					96
15	Miscellaneous crops					22				22
16	Forest products									
17	Greenhouse and nursery products	2,047	74				67	3,655		5,843
18	Agricultural services	1,863	62	2,062	679	12	766	158		107,619
	Total agriculture	6,673	139	6,184	828	36	875	3,869	16,703	2,317,450
	Total manufacturing and services	20,405	887	6,299	3,455	294	1,641	6,283	41,724	1,691,813
	Total primary inputs	72,274	3,289	8,307	5,438	1,227	37,082	25,493	66,162	2,350,664
	Gross domestic outlays	99,352	4,315	20,790	9,721	1,557	39,598	35,645	124,589	6,359,927

Table 21. Estimated total inputs of specified agricultural sectors in the East North Central subregion and the sectoral origin of the inputs, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other live-stock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
1	Meat animals	385,161								
2	Poultry and eggs		431							
3	Farm dairy products	39,496								
4	Other livestock and products				196					
5	Food crops	3,929	15,708			20,500				
6	Feed crops	794,377	95,402	659,348	4,890	713	41,842	1	83	893
7	Cotton									
8	Tobacco								9	
9	Oil-bearing crops	1,046								23,103
10	Vegetables	3,061								
11	Fruits									
13	Legume and grass seeds	2,856	26	1,750	3	603	15,294	1	49	850
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									
18	Agricultural services		41,837	14,296		17,274	47,109	36	754	20,298
	Total agriculture	1,229,926	153,404	675,394	5,089	39,090	104,245	38	895	45,144
	Total manufacturing and services	318,896	287,446	197,653	4,735	136,316	956,770	111	7,093	124,168
	Total primary inputs	506,200	93,526	383,498	57,354	142,745	1,430,851	162	13,072	228,040
	Gross domestic outlays	2,055,022	534,376	1,256,545	67,178	318,151	2,491,866	311	21,060	397,352

TABLE 21. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
1	Meat animals									385,161
2	Poultry and eggs								20,182	20,613
3	Farm dairy products									39,496
4	Other livestock and products									196
5	Food crops									40,137
6	Feed crops	392	50	77	60	9	80	214		1,598,431
7	Cotton									
8	Tobacco									9
9	Oil-bearing crops									24,149
10	Vegetables	5,229								8,290
11	Fruits									
13	Legume and grass seeds	416	1	5,276	32					27,157
14	Sugar and sirup crops				148		2	5		155
15	Miscellaneous crops					129				129
16	Forest products									
17	Greenhouse and nursery products	5,158	1,323				1,034	14,642		22,157
18	Agricultural services	5,183	1,113	1,857	639	83	1,531	664		152,674
	Total agriculture	16,378	2,487	7,210	879	221	2,647	15,525	20,182	2,318,754
	Total manufacturing and services	59,766	16,144	5,684	5,461	2,017	3,447	25,813	50,087	2,201,607
	Total primary inputs	190,850	58,393	5,252	8,157	7,936	70,476	101,600	97,805	3,395,917
	Gross domestic outlays	266,994	77,024	18,146	14,497	10,174	76,570	142,938	168,074	7,916,278

Table 22. Estimated inputs of specified agricultural sectors in the North Central Region, obtained from manufacturing and service sectors, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other live-stock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
19	Bituminous coal		82							
20	Mining of nonmetallic minerals (except fuels)	562	4	189		2,602	19,495	70	16	355
21	Food and kindred products	206,693	441,272	89,245	114	2,952	16,869	217	51	1,757
22	Textile mill products					129	18,494		162	52
23	Finished textile products				223					
24	Wood products									
25	Paper products		5,017	631						
26	Printing and publishing	1,842	263	807	37	467	1,831	50	18	223
27	Chemical products I	19,942	4,918	4,874	23	39,334	292,217	2,663	787	6,209
28	Chemical products II	74,626	3,438	18,909	12	265	1,598	14	6	173
29	Petroleum products	33,589	6,499	12,076	513	37,491	178,731	1,103	511	29,199
30	Rubber products	8,392	1,098	3,070	107	4,282	18,708	153	55	2,982
31	Stone, clay and glass products			5,008	423	78	681	3	2	162
32	Fabricated metal products	3,099	1,474	14,361	43	1,238	4,820	30	10	888
33	Machinery products	12,236	3,882	4,102	120	16,946	86,720	428	109	14,224
	Total manufacturing	360,981	467,947	153,272	1,615	105,784	640,164	4,731	1,727	56,224
34	Utilities	20,781	3,267	11,213	252	4,904	8,067	396	78	2,953
35	Margin industries	274,358	118,862	67,916	1,254	73,992	424,681	2,669	961	47,962
36	Telephone	11,391	1,809	4,841	168	3,134	12,753	114	47	1,674
37	Finance	31,738	4,397	12,462	428	21,331	54,320	658	626	9,491
38	Farm nonresidential rents	123,323	15,514	43,860	3,240	228,143	600,077	15,734	3,665	92,138
39	Miscellaneous business expenses	26,234	1,193	19,693	116	2,015	9,176	95	28	1,217
40	Repair services	20,609	6,197	6,969	246	34,794	180,358	876	218	29,725
41	Nonprofit membership organizations	2,632	306	9,850	42	631	2,661	39	14	337
42	Construction	51,586	7,643	19,633	704	12,308	56,732	481	386	7,937
	Total services	562,652	159,188	196,437	6,450	381,282	1,348,825	21,062	6,023	193,434
	Total manufacturing and services	923,633	627,135	349,709	8,065	487,066	1,988,989	25,793	7,750	249,658

TABLE 22. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
19	Bituminous coal							1,553		1,635
20	Mining of nonmetallic minerals (except fuels)	335	59	10	52	20		1		23,770
21	Food and kindred products	424	29	206	127	9	72	195		760,232
22	Textile mill products							230	7,780	26,847
23	Finished textile products	5,242								5,465
24	Wood products	10,022	1,591							11,613
25	Paper products							631	4,649	10,928
26	Printing and publishing	152	140	73	19		38	215	6	6,181
27	Chemical products I	17,151	4,270	1,562	1,712	329	27	551	2,508	399,077
28	Chemical products II	37	3	16	10	1	8	19		99,135
29	Petroleum products	5,236	1,315	1,659	1,046	59	634	2,290	17,277	329,228
30	Rubber products	659	171	354	117	8	77	245	2,661	43,139
31	Stone, clay and glass products	25	4		4	1		1,657	80	8,128
32	Fabricated metal products	185	37	28	32	6	50	69	3,551	29,921
33	Machinery products	2,335	606	494	458	26	145	484	8,058	151,373
	Total manufacturing	41,803	8,225	4,402	3,577	459	1,051	8,140	46,570	1,906,672
34	Utilities	1,174	405	720	157	23	155	397	3,828	58,770
35	Margin industries	17,575	3,834	3,243	2,145	298	1,173	12,121	33,220	1,086,264
36	Telephone	785	227	419	83	6	167	967	679	39,264
37	Finance	2,092	689	1,441	332	87	252	1,025	4,183	145,552
38	Farm nonresidential rents	20,025	1,676	4,189	5,976	1,459	1,545	2,255		1,162,819
39	Miscellaneous business expenses	356	238	233	58	4	103	5,100	13,259	79,148
40	Repair services	4,815	1,248	912	946	56	376	953	17,411	306,707
41	Nonprofit membership organizations	156	126	86	20	1	41	246		17,188
42	Construction	2,706	581	1,510	484	30	525	2,710	247	166,203
	Total services	49,684	9,024	12,753	10,201	1,964	4,337	25,774	72,827	3,061,917
	Total manufacturing and services	91,487	17,249	17,155	13,778	2,423	5,388	33,914	119,397	4,968,589

Table 23. Estimated primary inputs of specified agricultural sectors in the North Central Region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other live-stock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
43	Foreign trade									
44	Federal government	7,461	737	2,210	503	12,682	15,812	387	277	2,378
45	State and local government	138,418	14,386	46,645	1,735	38,961	149,259	1,117	489	18,640
46	Households	1,208,390	155,919	402,969	89,538	513,785	3,052,582	37,144	13,617	422,411
46.1	Wages and salaries	166,363	9,574	102,922	7,984	21,517	216,581	7,355	1,914	17,074
46.2	Proprietors' income	852,300	109,133	165,759	76,238	326,805	1,873,271	25,008	10,426	250,921
46.3	All others	189,727	37,212	134,288	5,316	165,463	962,730	4,781	1,277	154,416
46.3	Total primary inputs	1,354,269	171,042	451,824	91,776	565,428	3,217,653	38,648	14,383	443,429

TABLE 23. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup products 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18	Total agriculture
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
43	Foreign trade							351		351
44	Federal government	1,727	370	90	106	101	499	750	3,449	49,539
45	State and local government	6,373	2,259	5,197	1,022	562	772	2,775	3,322	431,932
46	Households	294,590	59,867	15,351	20,595	8,991	111,411	129,916	205,327	6,742,403
46.1	Wages and salaries	29,100	10,943	1,932	4,862	1,068	7,738	2,204	49,320	658,451
46.2	Proprietors' income	243,628	42,332	7,730	8,514	6,682	75,140	124,099	89,359	4,287,345
46.3	All others	21,862	6,592	5,689	7,219	1,241	28,533	3,613	66,648	1,796,607
46.3	Total primary inputs	302,690	62,496	20,638	21,723	9,654	112,682	133,792	212,098	7,224,225

Table 24. Estimated inputs of specified agricultural sectors in the Northern Plains obtained from manufacturing and service sectors, 1955.

Sector number	Item	Meat animals	Poultry and eggs	Farm dairy products	Other live-stock and products	Food crops	Feed crops	Tobacco	Oil-bearing crops
		1	2	3	4	5	6	8	9
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
19	Bituminous coal		12						
20	Mining of nonmetallic minerals (except fuels)	60		6		892	1,301		17
21	Food and kindred products	41,046	53,590	4,953	27	2,293	4,920		407
22	Textile mill products					81	5,327		3
23	Finished textile products				75				
24	Wood products		940	78					
25	Paper products		38	80	4	284	306		28
26	Printing and publishing	448	726	457	2	15,495	21,694		443
27	Chemical products I	4,239	244	1,818	3	196	420		34
28	Chemical products II	20,994	1,408	1,859	97	27,051	44,401	1	5,633
29	Petroleum products	11,547	197	377	17	2,853	3,873		471
30	Rubber products	2,484		616	44	30	51		9
31	Stone, clay and glass products		297	1,856	10	998	1,518		244
32	Fabricated metal products	1,373	798	590	21	11,947	20,445		2,590
33	Machinery and parts	4,040	58,250	12,690	300	62,120	104,256	1	9,879
33	Total manufacturing	86,231							
34	Utilities	4,530	403	956	26	2,794	1,529		320
35	Margin industries	73,645	16,017	9,259	230	49,014	86,236	1	8,760
36	Telephone	2,641	248	456	20	1,871	2,036		202
37	Finance	6,773	543	1,023	44	11,932	7,786		1,020
38	Farm nonresidential rents	28,007	2,094	4,116	378	136,029	94,370	9	10,969
39	Miscellaneous business expenses	6,849	182	2,915	17	1,316	1,695		172
40	Repair services	6,693	1,363	979	38	24,347	42,373		5,398
41	Nonprofit membership organizations	606	42	1,014	5	371	417		41
42	Construction	10,149	846	1,395	63	6,410	7,301	1	759
42	Total services	139,893	21,738	22,113	821	234,084	243,743	11	27,641
	Total manufacturing and services	226,124	79,988	34,803	1,121	296,204	347,999	12	37,520

TABLE 24. (continued)

Sector number	Item	Vegetables	Fruits	Legume and grass seeds	Sugar and sirup products	Miscellaneous crops	Forest products	Greenhouse nursery products	Agricultural services	Total agriculture
		10	11	13	14	15	16	17	18	(\$1,000)
		(\$1,000)	\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
19	Bituminous coal							78		90
20	Mining of nonmetallic minerals (except fuels)	16		1	8					2,301
21	Food and kindred products	104	1	91	69	1	7	20		107,529
22	Textile mill products							12	1,790	7,213
23	Finished textile products	693								768
24	Wood products	1,324	18							1,342
25	Paper products							32	498	1,548
26	Printing and publishing	20	1	22	7		1	10		1,249
27	Chemical products I	1,039	34	350	357	5	1	22	512	45,376
28	Chemical products II	8		7	5		1	2		23,732
29	Petroleum products	1,005	26	656	492	4	45	176	5,107	99,508
30	Rubber products	101	3	121	47		4	15	727	11,290
31	Stone, clay and glass products	2			1			83	8	844
32	Fabricated metal products	51	1	13	17		5	9	744	7,136
33	Machinery and parts	418	10	187	207	11	9	35	2,231	43,529
33	Total manufacturing	4,781	94	1,448	1,210	11	73	494	11,617	353,455
34	Utilities	126	8	187	59	14	6	17		11,324
35	Margin industries	2,531	55	1,156	866	13	91	693	8,575	257,142
36	Telephone	93	3	114	28		7	45	70	7,834
37	Finance	217	7	363	102	3	10	41	894	30,758
38	Farm nonresidential rents	2,390	19	1,124	2,004	66	66	104		281,745
39	Miscellaneous business expenses	52	4	71	22		6	259	1,426	14,986
40	Repair services	866	22	335	427	4	21	67	4,629	87,562
41	Nonprofit membership organizations	18	1	23	7		2	10		2,567
42	Construction	243	4	352	135	1	17	88	27	27,791
42	Total services	6,536	123	3,725	3,650	101	226	1,324	15,970	721,699
	Total manufacturing and services	11,317	217	5,173	4,860	112	299	1,818	27,587	1,075,154

Table 25. Estimated primary inputs of specified agricultural sectors in the Northern Plains, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock and products 4	Food crops 5	Feed crops 6	Tobacco 8	Oil-bearing crops 9
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
43	Foreign trade								
44	Federal government	2,130	89	116	54	3,922	2,245		160
45	State and local government	41,340	2,605	5,778	266	26,025	31,144	1	2,972
46	Households	324,814	21,179	-7,796	9,730	327,507	518,899	41	48,395
46.1	Wages and salaries	45,671	1,563	11,270	1,081	13,689	40,796	4	2,440
46.2	Proprietors' income	218,754	12,255	-37,802	7,738	198,341	258,993	32	18,834
46.3	All others	60,389	7,361	18,736	911	115,477	219,110	5	27,121
	Total primary inputs	368,284	23,873	-1,902	10,050	357,454	552,288	42	51,527

TABLE 25. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup products 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18	Total agriculture
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
43	Foreign trade							18		18
44	Federal government	215	5	29	37	5	16	37	369	9,429
45	State and local government	987	35	1,801	423	32	44	167	793	114,413
46	Households	38,363	775	5,248	7,670	454	5,065	6,477	46,968	1,353,789
46.1	Wages and salaries	3,990	139	618	1,857	53	385	114	6,937	130,607
46.2	Proprietors' income	30,555	518	2,535	2,617	316	2,202	6,077	22,723	744,688
46.3	All others	3,818	118	2,095	3,196	85	2,478	286	17,308	478,494
	Total primary inputs	39,565	815	7,078	8,130	491	5,125	6,699	48,130	1,477,649

Table 26. Estimated inputs of specified sectors in the Western Corn Belt obtained from manufacturing and service sectors, 1955.

Sector number	Item	Meat animals	Poultry and eggs	Farm dairy products	Other live-stock and products	Food crops	Feed crops	Cotton	Tobacco	Oil-bearing crops
		1	2	3	4	5	6	7	8	9
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
19	Bituminous coal		32							
20	Mining of nonmetallic minerals (except fuels)	206	1	38		340	5,800	69	1	101
21	Food and kindred products	97,001	185,466	40,875	36	266	6,699	216	7	725
22	Textile mill products					14	6,318		12	22
23	Finished textile products				70					
24	Wood products									
25	Paper products		1,998	188						
26	Printing and publishing	742	101	214	9	52	658	50	1	78
27	Chemical products I	8,017	1,886	1,235	5	5,281	88,536	2,649	52	2,004
28	Chemical products II	23,719	1,457	5,011	3	21	542	14	1	60
29	Petroleum products	11,980	2,340	3,113	125	3,105	59,515	1,098	41	9,892
30	Rubber products	2,963	377	726	24	377	5,968	152	5	952
31	Stone, clay and glass products			1,495	172	9	205	3		46
32	Fabricated metal products	1,002	556	4,255	11	80	1,587	30	1	299
33	Machinery and parts	4,285	1,354	1,009	28	1,400	28,028	426	9	4,650
	Total manufacturing	149,915	195,568	58,159	483	10,945	203,886	4,707	133	18,829
34	Utilities	8,011	1,174	2,704	58	541	2,575	394	6	979
35	Margin industries	113,156	49,157	24,846	379	7,177	142,903	2,657	82	16,450
36	Telephone	4,699	708	1,311	44	369	4,680	114	4	608
37	Finance	12,226	1,566	2,985	100	2,336	18,171	654	45	3,117
38	Farm nonresidential rents	53,305	6,380	12,651	905	28,630	232,121	15,672	332	35,336
39	Miscellaneous business expenses	11,237	488	6,244	34	240	3,603	94	3	478
40	Repair services	7,307	2,181	1,731	59	2,947	58,882	872	18	9,818
41	Nonprofit membership organizations	1,023	111	2,679	10	68	909	39	1	113
42	Construction	17,734	2,367	3,938	137	1,233	16,483	478	21	2,243
	Total services	228,698	64,132	59,089	1,726	43,597	480,330	20,974	512	69,142
	Total manufacturing and services	378,613	259,700	117,248	2,209	54,542	684,216	25,681	645	87,971

TABLE 26. (continued)

Sector number	Item	Vegetables	Fruits	Legume and grass seeds	Sugar and sirup products	Miscellaneous crops	Forest products	Greenhouse nursery products	Agricultural services	Total agriculture
		10	11	13	14	15	16	17	18	(\$1,000)
		(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)	(\$1,000)
19	Bituminous coal							296		328
20	Mining of nonmetallic minerals (except fuels)	57	2	4	12	2				6,633
21	Food and kindred products	118	2	74	30	2	29	50		331,596
22	Textile mill products							44	3,001	9,411
23	Finished textile products	1,234								1,304
24	Wood products	2,359	73							2,432
25	Paper products							120	1,878	4,184
26	Printing and publishing	33	8	27	5		12	38	6	2,034
27	Chemical products I	3,439	236	728	462	27	7	131	841	115,536
28	Chemical products II	9		5	2		3	3		30,850
29	Petroleum products	1,138	68	533	220	7	199	418	5,217	99,042
30	Rubber products	132	8	115	25	1	22	40	850	12,737
31	Stone, clay and glass products	4			1			316	22	2,273
32	Fabricated metal products	40	3	8	7	1	18	13	1,422	9,333
33	Machinery and parts	485	29	157	95	3	44	82	2,580	44,664
	Total manufacturing	9,048	429	1,651	859	43	334	1,551	15,817	672,357
34	Utilities	242	16	256	34	1	44	64	1,881	18,980
35	Margin industries	3,935	208	1,139	490	36	336	2,332	10,842	376,125
36	Telephone	183	12	160	22	1	54	179	290	13,438
37	Finance	428	31	515	80	9	70	165	1,573	44,121
38	Farm nonresidential rents	4,969	91	1,646	1,646	194	521	448		394,881
39	Miscellaneous business expenses	92	14	93	16	1	36	985	5,323	28,981
40	Repair services	1,012	61	295	200	6	112	166	5,900	91,567
41	Nonprofit membership organizations	33	5	31	5		11	41		5,079
42	Construction	463	20	482	103	3		352	98	46,284
	Total services	11,357	458	4,648	2,596	251	1,307	4,732	25,907	1,019,456
	Total manufacturing and services	20,405	887	6,299	3,455	294	1,641	6,283	41,724	1,691,813

Table 27. Estimated primary inputs of specified agricultural sectors in the Western Corn Belt, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other live-stock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
43	Foreign trade									
44	Federal government	2,564	221	253	133	3,264	6,322	385	29	991
45	State and local government	48,158	4,862	10,868	387	3,353	46,886	1,112	35	5,864
46	Households	429,063	48,561	59,112	23,852	58,606	1,181,310	36,990	1,205	157,006
46.1	Wages and salaries	57,015	3,125	22,716	1,697	1,890	65,832	7,313	125	5,156
46.2	Proprietors' income	301,727	31,714	1,171	20,821	41,844	785,736	24,916	971	98,394
46.3	All others	70,321	13,722	35,225	1,334	14,872	329,742	4,761	109	53,456
	Total primary	479,785	53,644	70,233	24,372	65,223	1,234,518	38,487	1,269	163,861

TABLE 27. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
43	Foreign trade							67		67
44	Federal government	414	18	38	27	11	203	145	1,393	16,411
45	State and local government	1,258	97	1,643	211	56	218	441	1,143	126,592
46	Households	70,602	3,174	6,626	5,200	1,160	36,661	24,840	63,626	2,207,594
46.1	Wages and salaries	5,446	433	605	1,000	103	2,044	327	16,384	191,211
46.2	Proprietors' income	60,297	2,400	4,110	2,595	906	32,482	24,266	24,102	1,458,452
46.3	All others	4,859	341	1,911	1,605	151	2,135	247	23,140	557,931
	Total primary	72,274	3,289	8,307	5,438	1,227	37,082	25,493	66,162	2,350,664

Table 28. Estimated inputs of specified sectors in the East North Central subregion obtained from manufacturing, service and primary input sectors, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other live-stock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
19	Bituminous coal		38							
20	Mining of nonmetallic minerals (except fuels)	296	3	145		1,370	12,394	1	15	237
21	Food and kindred products	68,646	202,216	43,417	51	393	5,250	1	44	625
22	Textile mill products					34	6,848		151	27
23	Finished textile products				79					
24	Wood products									
25	Paper products		2,079	365						
26	Printing and publishing	652	124	513	24	131	867		17	117
27	Chemical products I	7,688	2,306	3,182	15	18,558	181,987	14	735	3,762
28	Chemical products II	29,913	1,737	12,080	6	48	636		5	79
29	Petroleum products	10,062	2,751	7,104	291	7,335	74,785	5	466	13,674
30	Rubber products	2,945	524	1,967	66	1,052	8,867	1	50	1,559
31	Stone, clay and glass products			2,897	207	39	425		2	107
32	Fabricated metal products	724	620	8,250	22	160	1,717		9	345
33	Machinery and parts	3,911	1,730	2,503	71	3,599	38,247			6,984
	Total manufacturing	124,837	214,128	82,423	832	32,719	332,023	24	1,594	27,516
34	Utilities	8,240	1,690	7,553	168	1,569	3,963	2	72	1,654
35	Margin industries	87,554	53,688	33,806	645	17,797	195,537	11	877	22,753
36	Telephone	4,051	853	3,074	104	894	6,037		43	864
37	Finance	12,739	2,288	8,454	284	7,013	28,363	4	581	5,354
38	Farm nonresidential rents	42,011	7,040	27,093	1,957	63,484	273,583	62	3,324	45,833
39	Miscellaneous business expenses	8,149	523	10,534	65	489	3,878	1	25	567
40	Repair services	6,609	2,653	4,259	149	7,500	79,103	4	200	14,509
41	Nonprofit membership organization	1,003	153	6,157	27	192	1,335		13	183
42	Construction	23,703	4,430	14,300	504	4,659	32,948	3	364	4,935
	Total services	194,059	73,318	115,230	3,903	103,597	624,747	87	5,499	96,652
	Total manufacturing and services	318,896	287,446	197,653	4,735	136,316	956,770	111	7,093	124,168

TABLE 28. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
19	Bituminous coal							1,179		1,217
20	Mining of nonmetallic minerals (except fuels)	262	57	5	32	18		1		14,836
21	Food and kindred products		26	41	28	6	36	125		321,107
22	Textile mill products							174	2,989	10,223
23	Finished textile products	3,316								3,395
24	Wood products	6,339	1,500							7,839
25	Paper products							480	2,273	5,197
26	Printing and publishing	99	131	24	7		25	167		2,898
27	Chemical products I	12,673	4,000	483	892	297	18	397	1,155	238,162
28	Chemical products II	20	3	4	3	1	4	14		44,553
29	Petroleum products	3,093	1,221	470	334	48	390	1,696	6,953	130,678
30	Rubber products	426	160	118	45	7	51	190	1,084	19,112
31	Stone, clay and glass products	19	4		2	1		1,258	50	5,011
32	Fabricated metal products	94	33	8	8	5	27	47	1,385	13,454
33	Machinery and parts	1,432	567	150	156	22	92	367	3,247	63,180
	Total manufacturing	27,975	7,702	1,303	1,507	405	643	6,095	19,136	880,862
34	Utilities	806	381	277	64	8	105	316	1,598	28,466
35	Margin industries	11,109	3,570	949	788	249	746	9,096	13,803	452,978
36	Telephone	509	212	145	33	5	106	743	319	17,992
37	Finance	1,447	651	563	150	75	172	819	1,716	70,673
38	Farm nonresidential rents	12,666	1,566	1,388	2,326	1,199	958	1,703		486,193
39	Miscellaneous business expenses	212	220	69	20	3	61	3,856	6,510	35,182
40	Repair services	2,937	1,165	282	319	46	243	720	6,882	127,580
41	Nonprofit membership organizations	105	120	32	8	1	28	195		9,552
42	Construction	2,000	557	676	246	26	385	2,270	123	92,129
	Total services	31,791	8,442	4,381	3,954	1,612	2,804	19,718	30,951	1,320,745
	Total manufacturing and services	59,766	16,144	5,684	5,461	2,017	3,447	25,813	50,087	2,201,607

Table 29. Estimated primary inputs of specified agricultural sectors in the East North Central subregion, 1955.

Sector number	Item	Meat animals 1 (\$1,000)	Poultry and eggs 2 (\$1,000)	Farm dairy products 3 (\$1,000)	Other live-stock and products 4 (\$1,000)	Food crops 5 (\$1,000)	Feed crops 6 (\$1,000)	Cotton 7 (\$1,000)	Tobacco 8 (\$1,000)	Oil-bearing crops 9 (\$1,000)
43	Foreign trade									
44	Federal government	2,767	427	1,841	316	5,496	7,245	2	248	1,227
45	State and local government	48,920	6,919	29,999	1,082	9,583	71,229	5	453	9,804
46	Households	454,513	86,180	351,658	55,956	127,666	1,352,377	155	12,371	217,009
46.1	Wages and salaries	63,677	4,886	68,936	5,206	5,938	109,953	42	1,785	9,478
46.2	Proprietors' income	331,819	65,165	202,395	47,679	86,614	828,546	93	9,423	133,692
46.3	All other	59,017	16,129	80,327	3,071	35,114	413,878	20	1,163	73,839
	Total primary inputs	506,200	93,526	383,498	57,354	142,745	1,430,851	162	13,072	228,040

TABLE 29. (continued)

Sector number	Item	Vegetables 10 (\$1,000)	Fruits 11 (\$1,000)	Legume and grass seeds 13 (\$1,000)	Sugar and sirup products 14 (\$1,000)	Miscellaneous crops 15 (\$1,000)	Forest products 16 (\$1,000)	Greenhouse nursery products 17 (\$1,000)	Agricultural services 18 (\$1,000)	Total agriculture (\$1,000)
43	Foreign trade							266		266
44	Federal government	1,098	347	23	42	85	280	568	1,687	23,699
45	State and local government	4,128	2,127	1,753	388	474	510	2,167	1,386	190,927
46	Households	185,624	55,919	3,476	7,727	7,377	69,686	98,599	94,732	3,181,025
46.1	Wages and salaries	19,664	10,371	709	2,005	912	5,309	1,763	25,999	336,633
46.2	Proprietors' income	152,775	39,415	1,084	3,304	5,460	40,457	93,756	42,533	2,084,210
46.3	All other	13,185	6,133	1,683	2,418	1,005	23,920	3,080	26,200	760,182
	Total primary inputs	190,850	58,393	5,252	8,157	7,936	70,476	101,600	97,805	3,395,917

Table 30. Agricultural sector transactions, direct purchases per million dollars of output, North Central Region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other live-stock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	204,089								
2	Poultry and eggs		826							
3	Farm dairy products	10,298								
4	Other livestock and products				2,901					
5	Food crops	1,162	24,023			71,377				
6	Feed crops	404,771	221,747	591,686	97,513	3,099	19,233	5,353	4,153	2,971
7	Cotton							4,867		
8	Tobacco								433	
9	Oil-bearing crops	348								70,743
10	Vegetables	1,057								
11	Fruits									
13	Legume and grass seeds	1,390	49	1,393	36	1,894	6,512	1,915	2,293	2,140
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									
18	Agricultural services		70,762	10,962		52,955	18,562	119,002	35,688	50,234
	Total agriculture	623,115	317,407	604,041	100,450	129,325	44,307	131,137	42,567	126,088
	Total manufacturing	59,724	400,184	75,717	14,549	87,509	117,504	63,788	74,708	70,893
	Total services	93,091	136,136	97,040	58,112	315,416	247,580	283,980	260,544	243,901
	Total primary inputs	224,065	146,274	223,202	826,885	467,749	590,609	521,095	622,183	559,120

TABLE 30. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup products 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals								
2	Poultry and eggs								111,221
3	Farm dairy products								
4	Other livestock and products								
5	Food crops								
6	Feed crops	1,457	655	4,746	3,865	972	1,042	1,510	
7	Cotton								
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	25,342							
11	Fruits								
13	Legume and grass seeds	1,554	12	210,505	2,156		25	37	
14	Sugar and sirup crops				10,464				
15	Miscellaneous					13,036			
16	Forest products								
17	Greenhouse and nursery products	18,638	17,171				10,485	102,461	
18	Agricultural services	19,171	14,429	100,217	50,163	8,097	19,748	4,598	
	Total agriculture	66,162	32,267	315,468	66,648	22,105	31,300	108,606	111,221
	Total manufacturing	99,035	99,813	79,732	94,042	37,166	8,625	43,266	124,859
	Total services	117,706	109,510	230,990	268,194	159,029	35,583	136,995	195,257
	Total primary inputs	717,099	758,410	373,809	571,117	781,701	924,495	711,134	568,661

Table 31. Agricultural sector transactions, direct purchases per million dollars of output, Northern Plains region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock and products 4	Food crops 5	Feed crops 6	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	207,861							
2	Poultry and eggs		1,359						
3	Farm dairy products	5,187							
4	Other livestock and products				1,809				
5	Food crops	1,071	36,943			76,129			4,474
6	Feed crops	391,251	305,200	832,684	220,807	3,300	25,580	17,544	4,474
8	Tobacco								
9	Oil-bearing crops								98,076
10	Vegetables	1,201							
11	Fruits								
13	Legume and grass seeds	1,394	51	1,391		1,894	9,964		2,137
14	Sugar and sirup crops								
15	Miscellaneous								
16	Forest products								
17	Greenhouse and nursery products								
18	Agricultural services		65,874	10,280		52,476	18,272	35,088	49,380
	Total agriculture	608,069	409,427	844,355	222,616	133,799	53,816	52,632	154,067
	Total manufacturing	56,858	331,219	60,030	20,876	82,319	109,570	17,543	93,846
	Total services	92,241	123,608	104,611	57,133	310,198	256,168	192,981	262,585
	Total primary inputs	242,832	135,745	-8,998	699,374	473,683	580,443	736,841	489,499

TABLE 31. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup products 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals								
2	Poultry and eggs								57,250
3	Farm dairy products								
4	Other livestock and products								
5	Food crops								
6	Feed crops	1,596	939	5,039	3,908	1,616	1,050	1,674	
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	53,678							
11	Fruits								
13	Legume and grass seeds	1,542		142,989	2,171				
14	Sugar and sirup crops				11,145				
15	Miscellaneous crops					16,155			
16	Forest products								
17	Greenhouse and nursery products	11,873	16,901				30,960	102,553	
18	Agricultural services	18,760	13,146	99,177	42,698	8,078	19,241	4,500	
	Total agriculture	87,450	30,986	247,205	59,922	25,849	51,251	108,727	57,250
	Total manufacturing	85,745	88,263	88,977	87,566	17,772	12,769	51,695	144,644
	Total services	117,222	115,493	228,894	264,149	163,168	39,533	138,550	198,842
	Total primary inputs	709,583	767,136	434,927	588,364	793,215	896,449	701,026	599,266

Table 32. Agricultural sector transactions, direct purchases per million dollars of output, Western Corn Belt region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	215,627								
2	Poultry and eggs		645							
3	Farm dairy products	6,019								
4	Other livestock and products				3,397					
5	Food crops	595	12,821			61,330				
6	Feed crops	428,207	240,082	651,341	93,744	3,991	19,256	5,362	6,000	3,415
7	Cotton							4,888		
8	Tobacco								500	
9	Oil-bearing crops	365								78,074
10	Vegetables	609								
11	Fruits									
13	Legume and grass seeds	1,389	48	1,395	34	1,896	5,340	1,909	2,000	2,141
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									
18	Agricultural services		63,870	10,285		52,481	18,272	119,015	34,500	49,382
	Total agriculture	652,811	317,466	663,021	97,175	119,698	42,868	131,174	43,000	133,012
	Total manufacturing	60,633	425,991	104,536	16,407	80,447	101,705	63,733	66,500	64,823
	Total services	92,500	139,693	106,205	58,624	320,448	239,604	283,986	256,000	238,037
	Total primary inputs	194,054	116,849	126,238	827,796	479,404	615,821	521,108	634,500	564,128

TABLE 32. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup products 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals								
2	Poultry and eggs								
3	Farm dairy products								
4	Other livestock and products								134,065
5	Food crops								
6	Feed crops	1,349	695	4,954	3,395	1,285	1,035	1,515	
7	Cotton								
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	24,911							
11	Fruits								
13	Legume and grass seeds	1,550		193,314	2,057		25	56	
14	Sugar and sirup crops				9,876				
15	Miscellaneous crops					14,130			
16	Forest products								
17	Greenhouse and nursery products	20,604	17,149				1,692	102,539	
18	Agricultural services	18,752	14,368	99,182	69,849	7,707	19,344	4,433	
	Total agriculture	67,166	32,212	297,450	85,177	23,122	22,096	108,543	134,065
	Total manufacturing	91,071	99,420	79,414	88,365	27,618	8,436	43,512	126,954
	Total services	114,311	106,141	223,570	267,051	161,207	33,006	132,753	207,941
	Total primary inputs	727,454	762,225	399,567	559,407	788,054	936,462	715,192	531,042

Table 33. Agricultural sector transactions, direct purchases per million dollars of output, East North Central Region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other live-stock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	187,424								
2	Poultry and eggs		807							
3	Farm dairy products	19,219								
4	Other livestock and products				2,918					
5	Food crops	1,912	29,395			64,435				
6	Feed crops	386,554	178,530	524,731	72,792	2,241	16,791	3,215	3,941	2,247
7	Cotton									
8	Tobacco								427	
9	Oil-bearing crops	509								58,142
10	Vegetables	1,490								
11	Fruits									
13	Legume and grass seeds	1,390	49	1,393	45	1,895	6,138	3,215	2,327	2,139
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products									
18	Agricultural services		78,291	11,377		54,295	18,905	115,756	35,802	51,083
	Total agriculture	598,498	287,072	537,501	75,755	122,866	41,834	122,186	42,497	113,611
	Total manufacturing	60,746	400,707	65,595	12,383	102,839	133,243	77,168	75,686	69,247
	Total services	94,431	137,204	91,703	58,100	325,622	250,713	279,742	261,112	243,241
	Total primary inputs	246,322	175,019	305,201	853,761	448,671	574,209	520,900	620,703	573,899

TABLE 33. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup products 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals								
2	Poultry and eggs								
3	Farm dairy products								120,078
4	Other livestock and products								
5	Food crops								
6	Feed crops	1,468	649	4,243	4,139	885	1,045	1,497	
7	Cotton								
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	19,585							
11	Fruits								
13	Legume and grass seeds	1,558	13	290,753	2,207		26	35	
14	Sugar and sirup crops				10,209				
15	Miscellaneous crops					12,679			
16	Forest products								
17	Greenhouse and nursery products	19,319	17,176				13,504	102,436	
18	Agricultural services	19,412	14,450	102,337	44,078	8,158	19,995	4,645	
	Total agriculture	61,342	32,288	397,333	60,633	21,722	34,570	108,613	120,078
	Total manufacturing	104,778	99,994	71,806	103,952	39,806	8,397	42,639	113,855
	Total services	119,070	109,603	241,430	272,747	158,442	36,620	137,948	184,152
	Total primary inputs	714,810	758,115	289,430	562,667	780,027	920,413	710,798	581,916

Table 34. Agricultural interdependence: direct and indirect requirements per million dollars of delivery to processing and final demand, North Central Region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	1,256,422								
2	Poultry and eggs	1,202	1,009,426	2,564	218	6,439	2,220	13,465	4,050	6,109
3	Farm dairy products	12,939		1,000,000						
4	Other livestock and products				1,002,909					
5	Food crops	1,603	26,113	66	6	1,077,030	57	348	105	158
6	Feed crops	526,654	228,319	603,902	99,768	4,872	1,020,153	8,542	5,167	4,656
7	Cotton							1,004,891		
8	Tobacco								1,000,433	
9	Oil-bearing crops	471								1,076,129
10	Vegetables	1,363								
11	Fruits									
13	Legume and grass seeds	6,587	2,009	6,746	869	2,624	8,415	2,510	2,949	2,956
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products	28								
18	Agricultural services	10,798	77,251	23,033	1,955	57,843	19,939	120,965	36,387	54,882

TABLE 34. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup crops 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	* (\$)
1	Meat animals								
2	Poultry and eggs	2,245	1,632	14,265	5,731	923	2,226	579	112,269
3	Farm dairy products								
4	Other livestock and products								
5	Food crops	58	42	369	148	24	58	15	2,904
6	Feed crops	2,075	1,066	9,356	5,292	1,213	1,584	1,847	25,394
7	Cotton								
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	1,026,001							
11	Fruits		1,000,000						
13	Legume and grass seeds	2,038	25	1,266,711	2,804	10	46	68	223
14	Sugar and sirup crops				1,010,575				
15	Miscellaneous crops					1,013,208			
16	Forest products						1,000,000		
17	Greenhouse and nursery products	21,306	19,131				11,682	1,114,158	
18	Agricultural services	20,172	14,657	128,149	51,486	8,294	19,996	5,206	1,008,592

Table 36. Agricultural interdependence: direct and indirect requirements per million dollars of delivery to final demand, Western Corn Belt Region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	1,274,904								
2	Poultry and eggs	1,491	1,010,026	3,118	246	7,615	2,614	16,241	4,723	7,301
3	Farm dairy products	7,674		1,000,000						
4	Other livestock and products				1,003,409					
5	Food crops	829	13,796	43	3	1,065,441	36	222	65	100
6	Feed crops	562,139	247,215	664,924	95,974	6,213	1,020,308	9,483	7,290	5,579
7	Cotton							1,004,912		
8	Tobacco								1,000,500	
9	Oil-bearing crops	505								1,084,686
10	Vegetables	796								
11	Fruits									
13	Legume and grass seeds	5,935	1,730	6,131	678	2,546	6,754	2,442	2,529	2,916
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products	18								
18	Agricultural services	11,118	69,925	23,244	1,837	56,768	19,482	121,064	35,206	54,427

TABLE 36. (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup crops 14	Miscellaneous crops 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals								
2	Poultry and eggs	2,648	1,959	16,665	9,596	1,062	2,624	674	135,409
3	Farm dairy products								
4	Other livestock and products								
5	Food crops	36	27	228	131	15	36	9	1,850
6	Feed crops	2,105	1,218	10,342	5,859	1,589	1,701	1,887	33,156
7	Cotton								
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	1,025,547							
11	Fruits		1,000,000						
13	Legume and grass seeds	1,986	10	1,239,710	2,615	11	43	90	232
14	Sugar and sirup crops				1,009,974				
15	Miscellaneous crops					1,014,332			
16	Forest products						1,000,000		
17	Greenhouse and nursery products	23,545	19,108				1,885	1,114,254	
18	Agricultural services	19,742	14,602	124,222	71,532	7,916	19,557	5,026	1,009,374

Table 37. Agricultural interdependence: direct and indirect requirements per million dollars of delivery to final demand, East North Central Region, 1955.

Sector number	Item	Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock and products 4	Food crops 5	Feed crops 6	Cotton 7	Tobacco 8	Oil-bearing crops 9
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals	1,230,654								
2	Poultry and eggs	1,281	1,010,965	2,688	179	7,086	2,444	14,116	4,398	6,630
3	Farm dairy products	23,652		1,000,000						
4	Other livestock and products				1,002,926					
5	Food crops	2,555	31,764	84	6	1,069,096	77	444	138	208
6	Feed crops	496,733	183,650	534,209	74,287	3,736	1,017,560	5,854	4,823	3,645
7	Cotton							1,000,000		
8	Tobacco								1,000,427	
9	Oil-bearing crops	665								1,061,731
10	Vegetables	1,870								
11	Fruits									
13	Legume and grass seeds	6,770	1,744	6,588	707	2,889	8,807	4,586	3,325	3,235
14	Sugar and sirup crops									
15	Miscellaneous crops									
16	Forest products									
17	Greenhouse and nursery products	40								
18	Agricultural services	10,662	84,525	22,365	1,491	58,968	20,334	117,465	36,601	55,167

TABLE 37 (continued)

Sector number	Item	Vegetables 10	Fruits 11	Legume and grass seeds 13	Sugar and sirup crops 14	Miscellaneous 15	Forest products 16	Greenhouse nursery products 17	Agricultural services 18
		(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1	Meat animals								
2	Poultry and eggs	2,448	1,767	17,531	5,455	1,005	2,439	633	121,395
3	Farm dairy products								
4	Other livestock and products								
5	Food crops	77	56	551	171	32	77	20	3,814
6	Feed crops	2,011	1,010	9,269	5,258	1,094	1,529	1,812	22,052
7	Cotton								
8	Tobacco								
9	Oil-bearing crops								
10	Vegetables	1,019,976							
11	Fruits		1,000,660						
13	Legume and grass seeds	2,259	28	1,410,029	3,190	10	51	71	209
14	Sugar and sirup crops				1,010,314				
15	Miscellaneous crops					1,012,842			
16	Forest products						1,000,000		
17	Greenhouse and nursery products	21,954	19,136				15,045	1,114,127	
18	Agricultural services	20,367	14,702	145,876	45,395	8,365	20,294	5,267	1,010,150

Table 38. Direct and indirect 1975 requirements from agriculture, in constant 1955 dollars, and percent change from 1955 to 1975, by major region.

Sector	United States		North Central		All other regions	
	Total (\$1,000)	Percent change 1955-1975	Total (\$1,000)	Percent change 1955-1975	Total (\$1,000)	Percent change 1955-1975
1 -----	14,935,586	54.5	9,111,507	50.8	5,820,820	60.8
2 -----	5,547,182	59.5	1,490,706	27.5	4,062,920	76.0
3 -----	6,869,206	43.4	2,738,403	35.3	4,132,542	49.4
4 -----	352,324	15.5	130,053	17.2	222,269	14.5
Total livestock --	27,704,298	51.9	13,470,669	44.1	14,238,551	60.2
5 -----	2,558,668	16.0	1,406,874	16.4	1,148,385	15.3
6 -----	12,700,312	50.0	7,905,981	45.1	4,694,114	55.6
7 -----	3,254,662	23.7	97,539	31.5	3,157,126	23.5
8 -----	1,411,400	22.6	27,003	16.8	1,384,937	22.8
9 -----	1,592,383	41.9	1,085,569	36.9	507,044	54.1
10 -----	3,100,127	37.2	601,735	42.6	2,500,357	36.1
11 -----	1,740,838	40.5	111,394	35.2	1,629,444	40.8
12 -----	183,112	42.9	---	---	183,112	42.9
13 -----	235,129	37.8	83,894	52.0	152,482	32.2
14 -----	295,747	43.1	52,586	38.3	243,185	44.3
15 -----	57,471	13.6	13,121	6.2	44,611	16.7
16 -----	585,759	25.0	141,209	15.9	444,550	28.2
17 -----	797,740	26.6	215,444	14.5	582,310	31.7
Total crops -----	28,513,348	37.6	11,742,349	38.7	16,671,657	36.0
18 -----	1,594,278	41.2	485,255	30.1	1,129,228	49.4
Total agriculture	57,811,924	44.2	25,698,273	41.3	32,039,436	46.3

Table 39. Direct and indirect 1975 requirements from agriculture, in \$1,000, and percent change from 1955 to 1975, by subregion, North Central States.

Sector	Northern Plains		Western Corn Belt		East North Central	
	1975 requirement (\$1,000)	Percent change	1975 requirement (\$1,000)	Percent change	1975 requirement (\$1,000)	Percent change
1 -----	2,456,901	62.0	3,744,676	51.5	2,914,827	41.8
2 -----	212,596	20.9	628,598	36.9	649,378	21.5
3 -----	206,194	-2.5	817,550	46.9	1,712,130	36.3
4 -----	22,613	57.4	35,107	19.2	72,327	7.7
Total livestock --	2,898,304	51.1	5,225,931	48.6	5,348,662	36.7
5 -----	927,803	22.9	127,654	-6.2	351,125	10.4
6 -----	1,557,504	63.7	3,042,207	51.8	3,295,784	32.3
7 -----	---	---	97,228	31.6	311	---
8 -----	41	-28.1	2,473	23.6	24,488	16.3
9 -----	137,842	30.9	418,854	44.2	528,986	33.1
10 -----	70,378	26.2	129,035	29.9	401,874	50.5
11 -----	2,014	89.1	7,523	74.3	101,857	32.2
12 -----	---	---	---	---	---	---
13 -----	25,347	55.8	30,757	47.9	28,507	57.1
14 -----	19,104	38.3	13,440	38.3	20,043	38.3
15 -----	707	14.2	1,670	7.3	10,744	5.6
16 -----	7,935	38.8	42,416	7.1	90,859	18.7
17 -----	12,460	30.4	39,717	11.4	163,388	14.3
Total crops -----	2,761,135	44.2	3,952,974	45.4	5,017,966	30.8
18 -----	105,918	31.9	167,682	34.6	210,762	25.4
Total agriculture	5,765,357	47.3	9,346,587	47.0	10,577,390	33.6

demand of 1975 is \$3,408,794,000 from the continental United States, of which \$1,027,118,000 originates in the North Central Region, and \$2,408,838,000 originates in the remaining states. The north central demand for food and kindred products originates in the subregions as follows: \$147,963,000 in the Northern Plains, \$473,120,000 in the Western Corn Belt, \$411,211,000 in the East North Central States.

Table 41 contains the market disbursements of agricultural commodities to intermediate processing industries in 1975 by regions. The estimates show the potential volume of processing that could be carried on within the specified regions where the actual production occurs. Assuming a minimum of institutional restraints and sufficient quantities of primary resources, processing of the raw materials probably

would shift to the regions of production. This is true especially for perishable or bulky commodities such as meat and dairy products. However, labor-intensive processing industries, such as textile-mill-products industries, will continue to center around areas of abundant and cheap labor. Direct purchases by service sectors from the agricultural sectors will naturally occur at the place of the service.

Illustrating the quantities given in table 41, it can be seen that, with constant coefficients of market disbursements, meat packing will be a market outlet for \$11,086,777,000 worth of agricultural products in 1975 (valued at 1955 prices). It also indicates that, potentially, \$6,751,529,000 of the total production would occur in the North Central Region and that \$4,332,844,000 would occur in the remaining states.

Table 40. Direct requirements from the industrial sectors to meet the predicted agricultural output, in \$1,000, by regions, 1975.

Sector number	Item	Continental United States	North Central Region	Northern Plains Region	Western Corn Belt Region	East North Central
19	Bituminous coal	3,725	1,883	116	374	1,394
20	Mining of non-metallic minerals (except fuels)	92,989	33,686	3,385	9,828	19,401
21	Food and kindred products	3,408,794	1,027,118	147,963	473,120	411,211
22	Textile mill products	94,042	37,638	11,198	13,737	13,252
23	Finished textile products	63,161	7,734	993	1,686	5,076
24	Wood products	104,017	16,438	1,705	3,191	11,525
25	Paper products	44,570	14,021	1,911	5,673	6,422
26	Printing and publishing	14,470	8,683	1,827	2,980	3,856
27	Chemical products I	1,632,349	564,939	66,461	170,211	313,708
28	Chemical products II	373,428	145,490	37,088	46,261	62,077
29	Petroleum products	949,152	459,982	145,743	145,507	172,008
30	Rubber products	141,495	60,516	16,491	18,690	25,331
31	Stone, clay and glass products	26,012	10,627	926	3,179	6,461
32	Fabricated metal products	120,408	40,899	9,550	13,527	17,998
33	Machinery and parts	425,123	211,575	63,791	65,642	83,091
	Total manufacturing	7,493,735	2,641,229	509,148	973,606	1,152,811
34	Utilities	293,844	82,194	16,210	27,556	38,214
35	Margin industries	3,582,528	1,528,057	379,604	551,995	598,646
36	Telephone	124,694	55,246	11,451	19,719	23,954
37	Finance	462,972	202,615	43,691	64,260	93,237
38	Farm nonresidential rents	2,726,567	1,607,604	396,480	572,897	634,899
39	Miscellaneous business expenses	284,281	109,835	21,244	42,017	46,461
40	Repair services	865,770	428,486	128,341	134,500	167,647
41	Nonprofit membership organization	54,818	23,731	3,309	7,470	12,899
42	Construction	601,134	235,164	40,974	68,268	123,127
	Total services	8,996,608	4,272,932	1,041,304	1,488,682	1,739,084
	Total manufacturing and services	16,490,343	6,914,161	1,550,452	2,462,288	2,891,895

Table 41. Market disbursements of agricultural commodities to intermediate processing industries, in \$1,000, by regions, 1975.

Sector number	Item	Continental United States	North Central Region	Northern Plains Region	Western Corn Belt Region	East North Central
19	Meat packing	11,086,777	6,751,529	1,818,866	2,772,601	2,163,680
20	Poultry wholesale	1,390,129	373,572	53,277	157,527	162,735
21	Processed dairy products	6,018,677	2,368,469	180,353	710,519	1,475,437
22	All other food and kindred products	5,072,521	2,144,380	793,384	527,087	805,904
23	Tobacco manufacturing	1,056,890	20,781	259	2,007	18,515
24	Textile mill products	2,360,787	251,378	33,778	107,208	108,598
25	Wood products	321,406	77,184	4,335	23,214	49,636
26	Chemical and allied products	1,416,839	758,699	94,007	292,718	364,931
27	Leather tanning and other miscellaneous industries	121,792	58,138	10,348	16,050	24,318
	Total manufacturing	28,845,818	12,804,130	2,988,607	4,608,931	5,173,754
28	Eating and drinking places	759,187	174,723	22,963	61,246	90,467
29	Hospitals and education	87,777	19,409	2,531	6,969	9,904
30	Construction	260,469	70,372	4,097	12,994	53,321
31	All other service	14,071	6,658	1,230	2,479	2,940
	Total services	1,121,504	271,162	30,821	83,688	156,632
	Total manufacturing and services	29,967,322	13,075,292	3,019,428	4,692,619	5,330,386

Table 42. Direct requirements from the primary resource sectors to meet the predicted agricultural output, 1975, in \$1,000, by regions.

Sector number	Item	Continental United States	North Central Region	Northern Plains Region	Western Corn Belt Region	East North Central
43	Foreign trade	1,489	402	23	75	304
44	Federal government	195,121	66,829	13,401	22,274	30,253
45	State and local government	1,239,533	612,075	169,111	187,136	255,843
46	Households	23,953,931	9,448,408	2,021,558	3,223,976	4,213,288
46.1	Wages and salaries	3,974,598	928,926	194,100	279,749	451,586
46.2	Proprietors' income	14,443,769	6,005,412	1,125,406	2,121,916	2,760,044
46.3	All other	5,535,564	2,514,070	702,052	822,311	1,001,658

Primary resources are necessary directly for the production of the agricultural commodities. These include wages and salaries, proprietors' income and depreciation expense used in the production function of each agricultural sector. However, agricultural output, in turn, generates a demand for primary resources through the production of factor inputs and through processing of its products. Total employment generated by the agricultural segment of the

economy for any region, therefore, must include all three phases.

Substitution between primary resources is another factor in considering total resource requirements for any region. By fitting the production function given by equation 1.1, marginal rates of substitution between resources and productivity increases may be estimated.

For purposes of this report, total resource require-

ments are estimated for 1975 by assuming constant coefficients for the agricultural sectors. This should be taken only as a first approximation of resource use. Table 42 contains the direct requirements from the primary resource sectors to meet the predicted agricultural output in 1975 by regions. It is seen that the households sector, which includes both labor and depreciation expense, will be required to furnish \$23,953,931,000 dollars worth of resources with \$9,448,408,000 originating in the North Central Region and \$14,502,100,000 in the remaining states.

EVALUATING INVESTMENT PROSPECTS IN AGRICULTURE AND RELATED SECTORS

The pragmatic interest in this study—the generation of basic data for investment planning in the feed-livestock complex and other agricultural sectors—has been discussed generally in preceding sections of the report. However, the specific use of the findings may not be entirely clear from the introductory discussion on data needs for decision-making or from later discussions of the input-output matrices and related projections. To outline some uses of the data in investment planning, with particular reference to the feed-livestock complex in the North Central States, the economic implications of the results are reviewed briefly: first, in the context of total agricultural production; second, with reference to related studies of prospective shifts in the location of livestock slaughter; and, third, in terms of area economies.

Agricultural Production in the North Central States

With reference to the national agricultural economy, the projected 44-percent increase in total agricultural production cited earlier implies certain economic adjustments in the basic needs and desires of society. For example, differential preferences for food and fiber are implied, as suggested by the percentage change in the direct and indirect requirements from the 18 agricultural sectors, as shown in tables 38 and 39. According to these data, the meat-animals sector in the United States is expected to increase total activity by 54.5 percent by 1975. Likewise, the poultry-and-eggs sector and the farm-dairy-products sector are expected to increase total activity by 59.5 and 43.4 percent, respectively. On the other hand, the food-crops sector would increase total activity by only 16 percent, indicating a lower social preference for cereal foodstuffs relative to meat, eggs and milk.

The average annual rate of growth of slightly more than 2 percent in the total output of the agricultural segment of the economy also indicates certain basic requirements from society in the form of primary resources (table 42). Additional employment of primary resources is required in the processing of agricultural commodities and from the production of industrial inputs into agriculture because of the increases in agricultural activity summarized in table 17.

Regional average annual growth rates of the agricultural segment of the economy, as given in tables 14 and 15, are slightly more than 2 percent for both the North Central Region and all other states. Even though the annual growth rate is greater for other states than for the North Central Region, the absolute difference remains large for the meat-animals and the feed-crops sectors. The high growth rates of states outside the North Central Region are influenced substantially by the large population growth in such areas as the West Coast, the Eastern Seaboard and the population agglomerations encountered in the Gulf States. Finally, the meat-animals sector is expected to experience an annual growth rate of nearly 3 percent over the 20-year span, with the North Central Region expanding at a slightly slower rate than the rest of the nation.

Implications of Regional Agricultural Projections for Investment Planning in Livestock and Meat Sectors

With reference to the meat-animals sector, more detailed projections of regionally differentiated marketings, slaughter and meat consumption have been prepared for 1955 and 1965 for the major livestock classes—cattle, calves and hogs (15).⁷ These data are presented now on the basis of the regional delineation used in this study in terms of farm marketings and interregional shipments.

Farm marketings

According to the projected 1975 requirements for meat animals, a slightly slower rate of growth is envisioned for the North Central States than for the rest of the United States. The annual rates of change differ somewhat from the 1955 and 1965 estimates of farm marketings of cattle and hogs (summarized in tables 43 and 44). These estimates differ because of the underlying assumptions. While the 1975 estimates are based on regional projections of production trends, the 1955 and 1965 estimates are based, not on net farm production estimates, but on a more detailed series of estimates of farm inventories and marketings. Most important, however, the input-output estimates are based on dollar values, while the estimates of farm marketings are based on physical quantities. Regional differences exist in the value of livestock per hundredweight.

Two sets of figures on the physical volume of farm marketings are presented to illustrate regional differences in the composition of livestock sales according to intended use; i.e., slaughter or nonslaughter. Total farm marketings, which include both classes of livestock, are 25 to 30 percent above the volume of slaughter marketings in the case of cattle and calves and not quite as much above slaughter marketings in

7/ Although these projections were not extended to 1975, they do show trends in marketings and slaughter that can be used when comparing the two sets of estimates. The average annual change from 1955 to 1965, for example, can be extended to 1975, and the total change can be compared with the projected 1955-75 change shown in table 15.

Table 43. Estimated farm marketings of all cattle, calves and hogs, in million pounds liveweight, by region, 1955 and 1965.

Region	Cattle and calves			Hogs		
	Percentage change			Percentage change		
	1955	1965	1955-65	1955	1965	1955-65
North Central:						
East North Central	5,043	6,339	25.7	5,786	7,131	23.2
Western Corn Belt	6,160	8,539	38.6	7,173	8,505	18.6
Northern Plains	6,205	7,320	18.0	2,050	2,347	14.5
Total	17,408	22,198	27.5	15,009	17,983	19.8
Other	16,048	18,702	16.5	2,595	3,531	36.1
All regions	33,456	40,900	22.3	17,604	21,514	22.2

Table 44. Estimated farm marketings of slaughter cattle, calves and hogs, in million pounds liveweight, by region, 1955 and 1965.

Region	Cattle and calves			Hogs		
	Percentage change			Percentage change		
	1955	1965	1955-65	1955	1965	1955-65
North Central:						
East North Central	4,664	5,984	28.3	4,874	7,131	46.3
Western Corn Belt	5,633	7,959	41.3	7,173	8,505	18.6
Northern Plains	4,742	5,296	11.7	2,050	2,347	14.5
Total	15,039	19,239	27.9	14,097	17,983	27.6
Other	11,850	12,111	2.2	3,507	3,531	0.7
All regions	26,889	31,350	16.6	17,604	21,514	22.2

the case of hogs. As geographical specialization in livestock breeding and feeding increases, interfarm transfers also increase, thus contributing to a more rapid growth in the total volume of farm marketings than in farm production or slaughter marketings.

Interregional shipments

Because of year-to-year variability in the patterns of interstate shipments of livestock and meat, the "from-to" or regional trading coefficients from a multiregion input-output table are likely unstable. For example, livestock regions differ in average size of packing plants, degree of excess capacity and general competitive position; thus, the regional shares of total livestock slaughter also vary at different stages of the livestock cycles.

Among the interregional livestock shipment patterns, the one for feeder cattle shows the largest extent of cross hauling (table 45). To obtain the specified pattern of interregional shipments, the level of feeder-cattle outshipments and inshipments was first estimated for each of 26 regions. These estimates were

Table 45. Regional summary of estimated least-cost pattern of shipments of feeder cattle between 26 livestock regions, in million pounds liveweight, 1955.

Producing regions	Feeding regions						
	North Central					Other reg.	All reg.
	West-Central	Eastern North Central	North-Corn Belt	Northern Plains	Total		
North Central:							
East North Central	370	--	--	370	--	370	
Western Corn Belt	7	198	279	484	--	484	
Northern Plains	--	1,061	189	1,250	201	1,451	
Total	377	1,259	468	2,104	201	2,305	
Other	886	413	527	1,826	2,321	4,147	
All regions	1,263	1,672	995	3,930	2,522	6,452	

based on gross rather than net marketings; thus, a region could be represented as having both outshipments and inshipments. According to these estimates, the North Central States accounted for 2,305,000,000 pounds liveweight, or 36 percent, of the total outshipments. At the same time, this region accounted for 3,930,000,000 pounds, or 61 percent, of the total inshipments.

The specified levels of interregional trade were derived by use of an efficiency model of the livestock-meat economy. Transportation costs were minimized, given the location of calf production and cattle feeding. Actual shipment patterns, on the other hand, would not be the result of a minimizing procedure. Rather, cattle shipments are made on a week-to-week basis, given the short-run demand and supply conditions. In this extremely short-run context, transportation costs probably are minimized. In the long-run or annual context, however, considerable cross-hauling occurs because of the pervasive nature of the supply and demand restrictions on interregional cattle shipments. Consequently, the actual levels of shipments generally exceed the least-cost levels by substantial margins.

The least-cost pattern of interregional shipments of slaughter cattle and hogs is summarized in table 46. In the case of slaughter livestock, the North Central Region is the origin of 75 percent of the interregional shipments. Only 29 percent of the slaughter cattle and hogs in interregional trade are destined for markets in the North Central States.

Most of the livestock slaughtered in the North Central States also originate in these states. Moreover, very few livestock slaughtered in this region originate from other states. Thus, the pattern of interregional shipments for slaughter livestock differs radically from the shipment pattern for feeder cattle.

Fresh-meat shipments are substantially larger in the normatively competitive economy than in reality because of weight loss in slaughtering and processing together with near equivalence in the cost of shipping livestock and meat. The economies of plant location dictate proximity to livestock supplies rather than to consumer markets.

Table 46. Regional summary of estimated least-cost pattern of shipments of slaughter cattle, including calves and hogs, in million pounds liveweight, 1955.

Feeding regions	Slaughtering regions					
	North Central				Other regions	All regions
	East North Central	Western Corn Belt	Northern Plains	Total		
North Central:						
East North Central	100	--	--	100	1,331	1,431
Western Corn Belt	684	30	340	1,054	2,103	3,157
Northern Plains	756	325	--	1,081	203	1,284
Total	1,540	355	340	2,235	3,637	5,872
Other	58	--	--	58	1,941	1,999
All regions	1,598	355	340	2,293	5,578	7,871

A recapitulation of the data in tables 17, 43 and 44 should tie together the data from two different sources—the input-output estimates in 1955 dollars and the liveweight estimates of farm marketings. Of the \$4,218,000,000 increase in demand for meat animals, for example, \$2,442,000,000, or 58 percent, is attributed to the North Central States. Of the 12,825,000,000 pounds increase in marketing of slaughter cattle, calves and hogs for the shorter period, from 1955 to 1965, 8,575,000,000 pounds, or 67 percent, is attributed to the North Central States. The higher percentage in the latter case is quite plausible in the light of (a) the difference in definitions and (b) the substantial increase in shipments into the North Central States. Table 17 pertains to net farm production, while tables 43 and 44 pertain only to farm marketings. Accordingly, the 1955 levels of farm marketings in the North Central States, listed in table 43, are a larger fraction of total farm marketings than the corresponding farm production estimates in table 17.

Implications of Regional Agricultural Prospects for Area Marketing Systems

The input-output tables of the agricultural economy in the North Central Region are basic data for studies of subregional economic systems inasmuch as agriculture is an important part of the state and subregional economies of the North Central Region. For example, a current study of Iowa business responses to agricultural change is based partly upon the data generated by this study, particularly the technical coefficients that are used to generate data on agricultural purchases in the North Central States, in general, and Iowa, in specific. The regional data thus can serve as a basis for estimating the state-level input-output coefficients.

The use of input-output data in subregional analysis is illustrated in the sequence of tables that follow. First, an interindustry transactions table was prepared for Iowa agriculture (table 47). Estimates of gross output and interindustry transactions were obtained for 15 of the 18 sectors cited in the national table. In 1955, these 15 sectors accounted for a total agricultural output of \$3,071,890,000 of which \$1,506,098,000 originated from the meat-animals sector.

Subsequently, the 15 sectors were consolidated into six sectors for reporting. The technical, or input-output coefficients, were computed as shown in table 48, before preparation of the interdependence matrix (table 49). The latter table shows, for example, the requirements from the meat-animals sector (\$1,352,750), the poultry-and-eggs sector (\$708), the farm-dairy-products sector (\$4,524) and so on, per million dollars of delivery to the industrial and final-demand sectors. Altogether the direct and the indirect requirements total \$1,970,199 of agricultural products per million dollars of final delivery.

The substantial multiplier effects of deliveries to

industrial and final-demand sectors arises from the technical structure of Iowa agriculture. First of all, a million-dollar increase in demand for meat animals requires an additional \$260,765 of deliveries within the meat-animals sector (see table 48). For each million dollars of meat-animals output, \$3,344 of farm-dairy products are required or are forthcoming because of the complementarity between dairying and livestock production. Since the total output of meat animals covers the intrasector deliveries, direct purchases must be multiplied by a factor greater than one. Since total output now exceeds 1 million dollars, intrasectoral deliveries also must be increased, albeit less than in the first round. This iterative process must continue until the direct and indirect requirements converge to the values shown in table 49.

An increase in the demand for meat animals has the largest multiplier effect on the Iowa agricultural economy (as indicated by the sum of the direct and indirect requirements in table 49). The meat-animals sector is an intermediate stage in the processing of feed grains, thus depicting a rather high degree of vertical integration and resulting in a correspondingly high degree of technical interdependence.

With reference to the economy-wide study of Iowa, the availability of data encouraged use of the 1954 base year. In 1954, the gross agricultural output in Iowa was somewhat larger than in 1955. Nonetheless, the technical coefficients from the 1955 table generally were applicable to the 1954 table, particularly in the initial estimates of intersectoral transactions. However, additional sources of information were consulted in the Iowa economic study to adjust some of the technical coefficients. The level of intrasectoral transactions in the meat-animals sector, for example, was reduced. As a result of the lower proportion of total output required for intrasectoral transactions, the direct multiplier effect of deliveries to final demand was reduced. Thus, the 1954 Iowa interindustry transactions table is more correctly viewed as a "from-to" rather than an "input-output" table. The purchases of the Iowa sectors are from other Iowa sectors. An additional constraint thus is introduced into the economy-wide analysis.

The direct and indirect requirements per million dollars of delivery to final demand in the 7-sector Iowa study are summarized in table 50. In this table, a million-dollar delivery to the final-demand sector for meat animals requires only a \$1,166,260 gross output to cover both the final demand and the intrasectoral requirements. However, a million-dollar delivery to the final-demand sector for food manufacturing, largely meat and dairy products, requires a gross output for that sector of \$1,156,072, plus an additional gross livestock production of \$729,864. Final demand for meat livestock and livestock products, thus, would occur in two forms—as direct deliveries to final demand or out-of-state markets and as direct deliveries to the food-manufacturing sector in Iowa.

Table 47. Agricultural product shipments among intermediate demand sectors, in \$1,000, Iowa, 1955.

Producing sector	Input-output sector	Purchasing sectors								
		Meat animals 1	Poultry and eggs 2	Farm dairy products 3	Other livestock products 4	Food crops 5	Feed crops 6	Oil-bearing crops 9	Vegetables 10	Fruits 11
Meat animals	1	392,737								
Poultry and eggs	2		129							
Farm dairy products	3	5,036								
Other livestock and products	4				31					
Food crops	5	144	577			565				
Feed crops	6	647,970	43,772	110,496	1,087	8	16,422	137	13	
Oil-bearing crops	9	400						7,561		
Vegetables	10	74							131	
Fruits	11									
Legume and grass seeds	13	2,092	9	226		14	4,556	215	39	
Sugar and sirup crops	14									
Miscellaneous crops	15									
Forest products	16									
Greenhouse and nursery products	17									621
Agricultural services	18		12,363	1,668		386	18,351	4,956	470	10
Subtotal		1,048,453	56,850	112,390	1,118	973	39,329	12,869	1,274	22
Other purchases		457,645	127,701	49,798	8,789	6,377	964,994	87,490	23,785	668
Total purchases		1,506,098	184,551	162,188	9,907	7,350	1,004,323	100,359	25,059	690

TABLE 47 (continued)

Producing sector	Input-output sector	Purchasing sectors								Total production		
		Legume and grass seeds 13	Sugar and sirup crops 14	Miscellaneous crops 15	Forest products 16	Greenhouse and nursery products 17	Agricultural services 18	Total agricultural sales	Industrial and final demand			
Meat animals	1									392,737	1,113,361	1,506,098
Poultry and eggs	2									4,980	179,571	184,551
Farm dairy products	3									5,036	157,152	162,188
Other livestock and products	4									31	9,876	9,907
Food crops	5									1,286	6,064	7,350
Feed crops	6	10	2	1	2	7				819,927	184,396	1,004,323
Oil-bearing crops	9									7,961	92,398	100,359
Vegetables	10									205	24,854	25,059
Fruits	11										690	690
Legume and grass seeds	13	1,626	2			1				8,780	-2,766	6,014
Sugar and sirup crops	14		1							1	957	958
Miscellaneous crops	15			15						15	1,043	1,058
Forest products	16										5,436	5,436
Greenhouse and nursery products	17					28	1,298			1,959	10,700	12,659
Agricultural services	18	596	259	8	105	56				39,228	6,012	45,240
Subtotal		2,232	264	24	135	1,362	4,851	1,282,146	1,789,744	1,789,744	3,071,890	
Other purchases		3,782	694	1,034	5,301	11,297	40,389	1,789,744	--	--	--	
Total purchases		6,014	958	1,058	5,436	12,659	45,240	3,071,890	--	--	--	

Table 48. Direct purchases of specified agricultural sectors per million dollars of output, Iowa, 1955.

Producing sector	Meat animals	Poultry and eggs	Farm dairy products	Feed crops	Oil-bearing crops	Other
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
Meat animals	260,765	--	--	--	--	--
Poultry and eggs	--	699	--	--	--	42,415
Farm dairy products	3,344	--	--	--	--	--
Feed crops	430,231	237,181	681,283	16,350	1,365	9,880
Oil-bearing crops	266	--	--	--	75,340	--
Other	1,534	70,165	11,678	22,808	51,525	54,857
Subtotal	696,140	308,045	692,961	39,158	128,230	107,152
Other purchases	303,860	691,955	307,039	960,842	871,770	892,848

Table 49. Direct and indirect requirements per million dollars of delivery from agricultural sectors to specified industrial and final demand, Iowa, 1955.

Producing sector	Industrial and final demand					
	Meat animals	Poultry and eggs	Farm dairy products	Feed crops	Oil-bearing crops	Other
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
Meat animals	1,352,750	--	--	--	--	--
Poultry and eggs	708	1,004,112	12,384	1,045	2,513	45,072
Farm dairy products	4,524	--	1,000,000	--	--	--
Feed crops	595,141	242,923	693,199	1,017,122	2,701	21,534
Oil-bearing crops	389	--	--	--	1,081,478	--
Other	16,687	80,405	29,176	24,623	59,209	1,061,907
Totals	1,970,199	1,327,440	1,734,759	1,042,790	1,145,901	1,128,513

Table 50. Direct and indirect requirements per million dollars of delivery from major economic sector to specified final demands, Iowa, 1954.

Producing sector	Agriculture		Manufacturing			Regulated industries	Trade and services
	Livestock	Crops	Food	Farm machinery	Other		
	(\$)	(\$)	(\$)	(\$)	(\$)		
Livestock production	1,166,260	7,826	729,864	3,235	12,983	3,628	8,140
Crop production ^a	521,319	1,127,308	407,468	17,525	77,523	5,838	8,649
Food manufacturing	85,277	11,740	1,156,072	4,864	19,930	5,311	9,706
Farm machinery	2,651	3,739	2,112	1,074,299	5,340	444	509
Other manufacturing ^b	47,575	67,383	75,430	294,720	1,321,037	58,492	64,997
Regulated industries	64,739	38,121	74,889	43,156	54,989	1,073,452	57,138
Trade and services	171,688	229,195	156,999	58,600	78,979	81,451	1,144,227
Totals	2,059,509	1,485,312	2,602,834	1,496,399	1,570,779	1,228,616	1,293,366

^a Including agricultural services.

^b Including mining.

LITERATURE CITED

1. Allin, Bushrod W. Major agricultural policy questions of the next 15 years. Paper presented at the 1959 Agricultural Policy Conference, Estes Park, Colorado, Sept. 17, 1959.
2. Carter, Harold A. and Earl O. Heady. An input-output analysis emphasizing regional and commodity sectors of agriculture. Iowa Agr. and Home Econ. Exp. Sta. Res. Bul. 469. 1959.
3. Cyert, Richard M. and James G. March. A behavioral theory of the firm. Prentice-Hall, Inc., New York. 1963.
4. Daly, Rex F. Prospective domestic demands for food and fiber. In: Policy for commercial agriculture. U. S. Govt. Print. Off., Washington, D. C. 1957. p. 110.
5. Dorfman, Robert, Paul A. Samuelson and Robert M. Solow. Linear programming and economic analysis. McGraw-Hill Book Company, Inc., New York. 1958.
6. Evans, W. Duane and Marvin Hoffenberg. The inter-industry relations study for 1947. Rev. Econ. and Stat. 34: 97-142. 1952.
7. Heady, Earl O. and Wilfred V. Candler. Linear programming methods. Iowa State University Press, Ames, Iowa. 1958.
8. Isard, Walter. Interregional and regional input-output analysis: A model of a space economy. Rev. Econ. and Stat. 33: 318-328. 1951.
9. Jennings, R. D. Consumption of feed by livestock, 1909-56. U. S. Dept. Agr., Prod. Res. Rept. 21. 1958.
10. ———. Feeds consumed by livestock, 1949-50, by states. U. S. Dept. Agr. Stat. Bul. 145. 1954.
11. Koffsky, Nathan M. Potential demand for farm products of the next quarter century. In: Dynamics of Land Use—Needed Adjustment. Iowa State University Press, Ames, Iowa. 1961. pp. 40-48.
12. Leontief, Wassily. The structure of the American economy, 1919-1939. Second ed. Oxford University Press, New York. 1951.
13. ———. Studies in the structure of the American economy. Oxford University Press, New York. 1953.
14. Maki, Wilbur R. Forecasting beef cattle and hog prices by quarter years. Iowa Agr. and Home Econ. Exp. Sta. Res. Bul. 473. 1959.
15. ———. Transportation costs and the location of the meat packing industry. In: Private and unregulated carriage. Transportation Center, Northwestern University, Evanston, Ill. 1963. pp. 96-127.
16. ———, Charles F. Liu and William C. Motes. Inter-regional competition and prospective shifts in the location of livestock slaughter. Iowa Agr. and Home Econ. Exp. Sta. Res. Bul. 511. 1962.
17. Masucci, Robert H. Dollar volume of agriculture's transactions with industry. U. S. Dept. Agr. Marketing Res. Rept. 375. 1959.
18. Peterson, G. A. and Earl O. Heady. Application of input-output analysis to a simple model emphasizing agriculture. Iowa Agr. Exp. Sta. Res. Bul. 427. 1955.
19. Rogers, Robert O. and Glen T. Barton. Our farm production potential 1975. U. S. Dept. Agr. Inf. Bul. 233. 1960.
20. Schnittker, John Alvin and Earl O. Heady. Application of input-output analysis to a regional model emphasizing agriculture. Iowa Agr. and Home Econ. Exp. Sta. Res. Bul. 454. 1958.
21. Standard Industrial Classification Manual. Prepared by the Technical Committee on Industrial Classification, Office of Statistical Standards, U. S. Govt. Print. Off., Wash., D. C. 1957.
22. U. S. Bureau of the Census. Census of Agriculture, 1950. General Report, Vol. 2. 1950.
23. ———. Census of Agriculture, 1954. General Report, Vol. 2. 1954.
24. ———. Census of Agriculture, 1954. Special Reports, Vol. 3. Part II. 1954.
25. ———. Statistical abstract of the United States, 1956. U. S. Govt. Print. Off., Wash., D. C. 1956.
26. U. S. Department of Agriculture. Agricultural Statistics, 1954-1959. 1955-1960.
27. ———. Major statistical series. Vol. 3: Gross and net farm income. Agriculture Handbook 118. 1957.
28. ———. Agricultural Marketing Service. Cumulative supplement for 1945-57 to wool statistics and related data. U. S. Dept. Agr. Stat. Bul. 142. 1958.
29. ———. Agricultural Marketing Service. Improving the marketing of tung nuts. U. S. Dept. Agr. Marketing Res. Rept. 281. 1958.
30. ———. Agricultural Marketing Service. Crop Reporting Board. Chickens and eggs, farm production disposition, cash receipts, gross income by states, 1954-55. 1956.
31. ———. Agricultural Marketing Service. Crop Reporting Board. Chickens and eggs, farm production, disposition, cash receipts, gross income by states, 1955-56. 1956.
32. ———. Agricultural Marketing Service. Crop Reporting Board. Cotton and cottonseed production, 1956. 1957.
33. ———. Agricultural Marketing Service. Crop Reporting Board. Crop production: acreage, yield and production of principal crops by states, 1956. 1956.
34. ———. Agricultural Marketing Service. Crop Reporting Board. Field and seed crops: farm production, farm disposition and value, by states, 1954-55. 1956.
35. ———. Agricultural Marketing Service. Crop Reporting Board. Field and seed crops: farm production, farm disposition and value, by states, 1955-56. 1957.
36. ———. Agricultural Marketing Service. Crop Reporting Board. Honey, annual summary, 1957. 1958.
37. ———. Agricultural Marketing Service. Crop Reporting Board. Meat animals, farm production, disposition and income, by states, 1955-56. 1957.
38. ———. Agricultural Marketing Service. Crop Reporting Board. Milk, farm production, disposition and income, 1955-56. 1957.
39. ———. Agricultural Marketing Service. Livestock and Meat Statistics. U. S. Dept. Agr. Stat. Bul. 230. 1957.
40. ———. Agricultural Marketing Service. Crop Reporting Board. Potatoes and sweet potatoes: estimates by states and seasonal groups, crops of 1955 and 1956. 1957.
41. ———. Agricultural Marketing Service. Crop Reporting Board. Seed crops, annual summary, 1956. 1956.
42. ———. Agricultural Marketing Service. Crop Reporting Board. Vegetables: fresh market, annual summary, 1956. 1956.
43. ———. Agricultural Marketing Service. Farmers' expenditures in 1955 by regions. U. S. Dept. Agr. Stat. Bul. 224. 1958.
44. Waldorf, William H. Input-output analysis as a tool in agricultural marketing research. Agr. Econ. Res. 14: 95-111. 1962.

STATE LIBRARY OF IOWA



3 1723 02095 0473