THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA

BY

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PREFACE

This study was undertaken under the terms of a contract between the Bureau of Reclamation of the United States Department of the Interior and the University of Nebraska Bureau of Business Research. Preliminary investigations were begun during the summer of 1965 on the feasibility of undertaking this type of research. The research team at that time was composed of the Project Director and Dr. Ronald A. Wykstra, who was then a member of the Economics Department of the University of Nebraska. The recommendation of this team was that the economic impact of irrigated agriculture on Nebraska's economy be measured through the use of input-output tables which would need to be constructed.

After the decision to undertake the impact analysis was made, the research was conducted by the Project Director and the Associate Director. The latter joined the Economics Department of the University of Nebraska in September, 1966. Mr. M. David Beveridge, a graduate student in the Economics Department of the University, also contributed substantially to the research and the writing of this report.

Several graduate students of the University of Nebraska, in connection with their research for their master's theses, also undertook studies from which this project benefited. They were John Hemphill, Robert Jensen, and Henry Norris. The authors are also grateful for the manifold services to this project rendered by the staff of the Bureau of Business Research. In particular the cooperation of the following members of the staff of the Bureau is hereby acknowledged: Dr. E. S. Wallace, Director; Dr. E. L. Hauswald, Associate Director; and Mrs. Dorothy Switzer, Editorial Assistant.

Much of the data required in this study was obtained from Nebraska businessmen whose cooperation in completing "another" questionnaire was much appreciated. The cooperation of the Urban Studies Center of the University of Omaha (now the University of Nebraska at Omaha) in contacting Omaha businessmen is hereby acknowledged. The assistance of various state and Federal government agencies and officials in tracking down necessary data was also most helpful. Numerous suggestions and comments from which the study benefited were also received from colleagues at the University of Nebraska, particularly in the College of Business Administration and in the Departments of Agricultural Economics and Agricultural Engineering.

The analysis and the conclusions based thereon are of course the responsibility of the authors.

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CHAPTER I

INTRODUCTION AND SUMMARY

OBJECTIVE

The practice of irrigation has grown at a very rapid rate in Nebraska in the postwar period. The number of acres under irrigation has more than tripled. According to the Nebraska Department of Agriculture, over 3 million acres of Nebraska farmland were irrigated from either surface or underground water or both in 1966. Furthermore, between 1947 and 1963 the fraction of the value of total crop production supplied by irrigated land increased from 10 percent to 27 percent.[1]

Because of this development, considerable interest has focused on the question of the impact of irrigated agriculture on the state's economy. The objective of this study was to measure the economic impact of irrigated agriculture on the economy of the State of Nebraska during the period since World War II. Since more data were available for the year 1963, the impact during that year was estimated in more detail. As used here the term "irrigated agriculture" refers to the package of resources of which irrigation is one part. The problem of measuring the contribution of water separately was not considered.

The concept of "economic impact" is an exceedingly broad term and subject to several interpretations. As used here, the term is intended to include both the direct impact on agriculture's gross income and the indirect effects resulting from changes in this income. The concern is with the impacts on the aggregate incomes of agriculture and other industries of the state. These income effects can lead to investment activity in agriculture and in related industries. The feasibility of measuring such activity was also considered. No attempt was made to analyze effects upon the internal structure and functioning of agriculture or other industries which have important relations with agriculture.

It should be noted here that a regional point of view—not a national point of view—was assumed with respect to impact measurement. Furthermore, the economic impact considered here is not net of the direct and indirect impact of alternative uses of resources outside of crop production.

[1] These facts were based on data reported in Nebraska Department of Agriculture and Inspection, *Nebraska Agricultural Statistics, Annual Reports.*

TYPES OF IMPACTS

For purposes of this study, the economic impact of the Irrigated Crops Sector on the state's economy was separated into (1) the current impact and (2) the investment impact. The current impact refers to the short-run impact due to the additional crop production attributed to irrigation during any production and processing period. The investment impact is the long-run impact resulting from investment activity in all sectors, including Irrigated Crops, which may be attributed to the expansion of Irrigated Crops' output.

The current impact was further subdivided into direct, indirect induced-by, and indirect stemming-from impacts. The *current direct impact* is the net increase in the output of the Irrigated Crops Sector over what would have been produced under dryland farming conditions. The latter was estimated using typical dryland production conditions for the counties involved in irrigation. The net gain in production due to irrigation was then computed. For 1963, this net gain in crop output was estimated to have a value of $121.6 million. This impact is shown in Chart 1.1 in the middle section of the flow diagram.

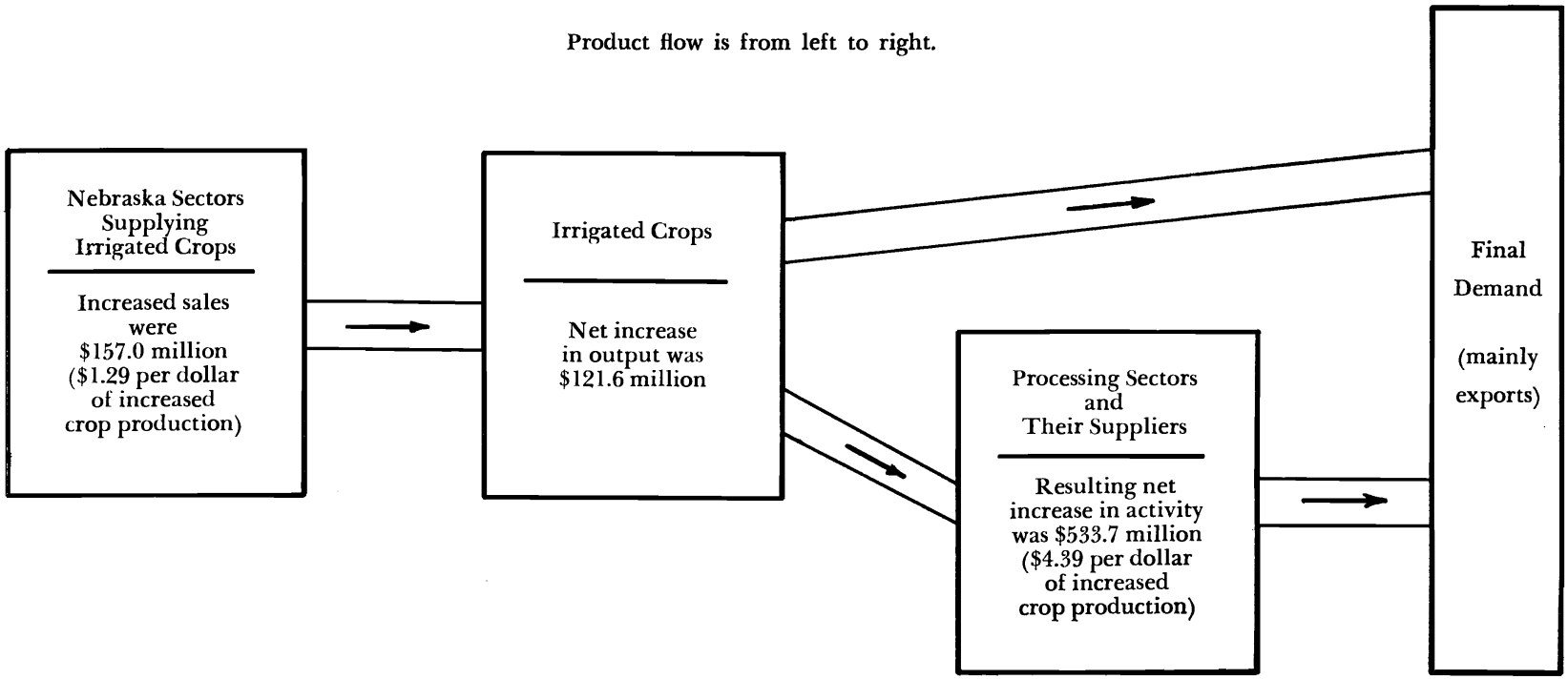
The *current induced-by effect* (or impact) refers to the increases in the activity of the Nebraska sectors which are required to enable these sectors to sell the necessary inputs to Irrigated Crops so that this sector can produce the net increase in output. For example, inputs of fertilizer, seed, and labor, among others, are required by Irrigated Crops. Various financial and other services are also needed. In 1963 this induced-by effect totaled $157.0 million, as is indicated in the left-hand section of Chart 1.1. In other words, to support the net increase in output by Irrigated Crops, the Nebraska sectors which served as direct or indirect suppliers of Irrigated Crops experienced increased sales of $157.0 million in 1963. This amounts to $1.29 of induced activity per dollar of increased output of Irrigated Crops.

It was estimated that the Nebraska crop producing sectors sold about 61 percent of their production outside the state in 1963. Most of the remaining 39 percent was sold to several processing sectors which in turn exported substantial amounts of

CHART 1.1

Current Impacts of Irrigated Agriculture in Nebraska in 1963

Product flow is from left to right.



Induced-by Effect **Direct Impact** **Stemming-from Effect**

Source: See Chart 5.2

products from the state. The *current stemming-from effect* (or impact) refers to the increases in activity of the Nebraska economy which were required to enable the processing sectors to process and sell to Final Demand a part of the increased output of Irrigated Crops. The processing sectors identified in this study were: (1) Livestock and Livestock Products, (2) Meat Products, (3) Dairy Products, (4) Grain Products, and (5) Other Foods.

This stemming-from effect is shown in the right-hand portion of Chart 1.1. It involved activities valued at $533.7 million in 1963. This is the equivalent of approximately $4.39 worth of stemming-from activity per dollar of increased sales to Final Demand by the processing sectors and the required supporting activity of Nebraska suppliers, except that required for crop production. This latter activity has already been accounted for under the direct and induced-by effects. It should be noted that this stemming-from effect is not required for the production of the net increase of Irrigated Crops as is the induced-by effect. The stemming-from effect can be better described as *associated with* the net increase of Irrigated Crops. While something approaching a casual relationship may exist in some cases (e.g., sugar beet production and sugar beet processing), in other cases the processing activity might well continue even if the production of Irrigated Crops in Nebraska were not available.

In addition to the current impacts, the other broad category of impacts of concern here is investment impact. This can be subdivided into direct and indirect impacts. The *direct investment impact* resulting from irrigated agriculture refers (1) to investments needed to provide the water supply used for irrigation, (2) to investments needed to distribute the water to the cropland, and (3) to the other additional farm investments needed to produce the irrigated crops. Included would be investments in reservoirs, dams, and canals which provide water for irrigation, and also investments on farms in wells, pumps, pipes, sprinkler systems, land preparation, and additional farm machinery needed. The current activity of suppliers generated by these investments is also included in the direct investment impact.

The *indirect investment impact* resulting from irrigated agriculture is the investments made by suppliers of agriculture whose products are required for irrigated farming and the investments of processors of the products of irrigated agriculture. For example, the investments made by manufacturers of irrigation equipment in response to the demand for such equipment would be included here, as would the investments by grain mills to the extent that these investments can be associated with the processing of irrigated crops. The current activity induced by these investments is also included in the indirect investment impact.

The types of impacts with which this study has been concerned may be summarized as follows:

- Current impacts
  - Direct
  - Indirect
    - Induced-by
    - Stemming-from
- Investment impacts
  - Direct
  - Indirect

These terms will be used frequently in this report. The reader may find it convenient to refer back to the definitions given above and to this outline of the types of impacts.

The methodology used in the study is best adapted to the measurement of current impacts, for which some results have been noted in Chart 1.1. The measurement of investment impacts requires a more dynamic model and more basic data than were used in this study. Some estimates of the direct investment impact were obtained, however, as will be noted shortly.

ESTIMATES OF IMPACTS

In the process of explaining the types of impacts in the preceding section, the current direct, induced-by, and stemming-from impacts of irrigated agriculture in Nebraska in 1963 were noted. These are summarized in Table 1.1, which gives the total of the current impacts in 1963 and also expresses these in terms of current impact per dollar of net increase in output and current impact per acre of irrigated land.[2] If the impact for a larger unit of output than one dollar or for a larger piece of land than one acre is desired, appropriate multipliers may be applied.

These types of impacts given in Table 1.1 are separate impacts. The current direct and induced-

[2] It should be kept in mind that the impacts referred to in this study are estimates. While numbers with more than three or four significant digits are frequently used in indicating the impact, it is suggested that these be rounded to three or four significant digits when reference is made to these individually. More significant digits are frequently indicated because these numbers may be used in further computations. In such cases the rounding to three or four significant digits should occur after the computations.

TABLE 1.1

Summary of Current Impacts of Irrigated Agriculture on the Nebraska Economy, 1963

	Current Impacts		
	Direct	Induced-by	Stemming-from
Total	$121,643,000	$156,959,000	$533,734,000
Impact per Dollar of Net Increase in Output of Irrigated Crops	$1.00	$1.29	$4.39
Impact per Acre of Irrigated Land	$45.27	$58.41	$198.64

Source: See Chart 5.2.

by impacts are often combined into a total requirements impact since both are required if the output of Irrigated Crops is to be increased. Thus, the direct and induced-by impacts total $2.29 per dollar of increased output of Irrigated Crops. Because the stemming-from effects are *associated with* rather than *required by* the increased output of Irrigated Crops, as explained above, it may be misleading to add the stemming-from effects to the other impacts.

Estimates of the direct and induced-by effects for the years 1946 to 1965 were computed by using the output multipliers which were developed for this period. Not enough data were available to develop a series of stemming-from effects for the entire postwar period. Chart 1.2 shows the current direct and induced-by effects in the postwar period along with the number of irrigated acres for each of the years. The latter has increased from less than one million acres in 1946 to close to three million acres in 1965. The direct and the indirect effects have approximately tripled in this period.

It is apparent from Chart 1.2 that the impact curves show more variation around the long-term trend than is the case for the acres irrigated. Variations in the weather and prices of crops no doubt account for most of this variation. It should be recalled that the direct effect is the net increase in output due to irrigation. What could have been grown through dryland farming has been subtracted from the irrigated output. This dryland equivalent production has, of course, shown much more variation than the irrigated output.[3]

The total induced-by effect of irrigated agriculture in 1963 was $157.0 million, as noted in Chart 1.1. This means that the Nebraska sectors which supplied the Irrigated Crops Sector with inputs experienced increased transactions summing to this amount. Input-output analysis may be used to disaggregate this total induced-by impact into the increased transactions experienced by each sector. This has been done in the body of this report in Table 5.9.

[3] See Table 5.1.

TABLE 1.2

Induced-by Effects in Nebraska in 1963 by Sector per $10,000 of Net Increase of Output by Irrigated Agriculture and per 100 Acres of Irrigated Land

	Current Induced-by Effects	
Sector	Per $10,000 Net Output	Per 100 Irrig. Acres
Livestock and L. S. Products	$ 661.95	$ 299.67
Irrigated Crops	.....	.....
Dryland Crops	.....	.....
Mining	103.83	47.01
Meat Products	86.11	38.98
Dairy Products	93.97	42.54
Grain Products	64.32	29.12
Other Foods	155.08	70.21
Farm Machinery	11.67	5.28
Other Machinery	6.84	3.10
Metals	17.72	8.02
Agricultural Chemicals	100.47	45.48
Other Chemicals	7.76	3.51
All Other Manufacturing	75.71	34.27
Trade	1,318.14	596.73
Finance	289.85	131.22
Insurance	124.32	56.28
Real Estate	2,796.11	1,265.82
Transportation	226.95	102.74
Utilities	497.51	225.23
Services	921.36	417.11
Construction	.....	.....
Households	5,242.27	2,373.23
TOTAL	$12,906.21[a]	$5,841.42[a]

[a] This total was not computed by summing the column but by a method described in Chapter V applicable to the total induced-by impact. Because of this, the column sum varies slightly from the total given here.

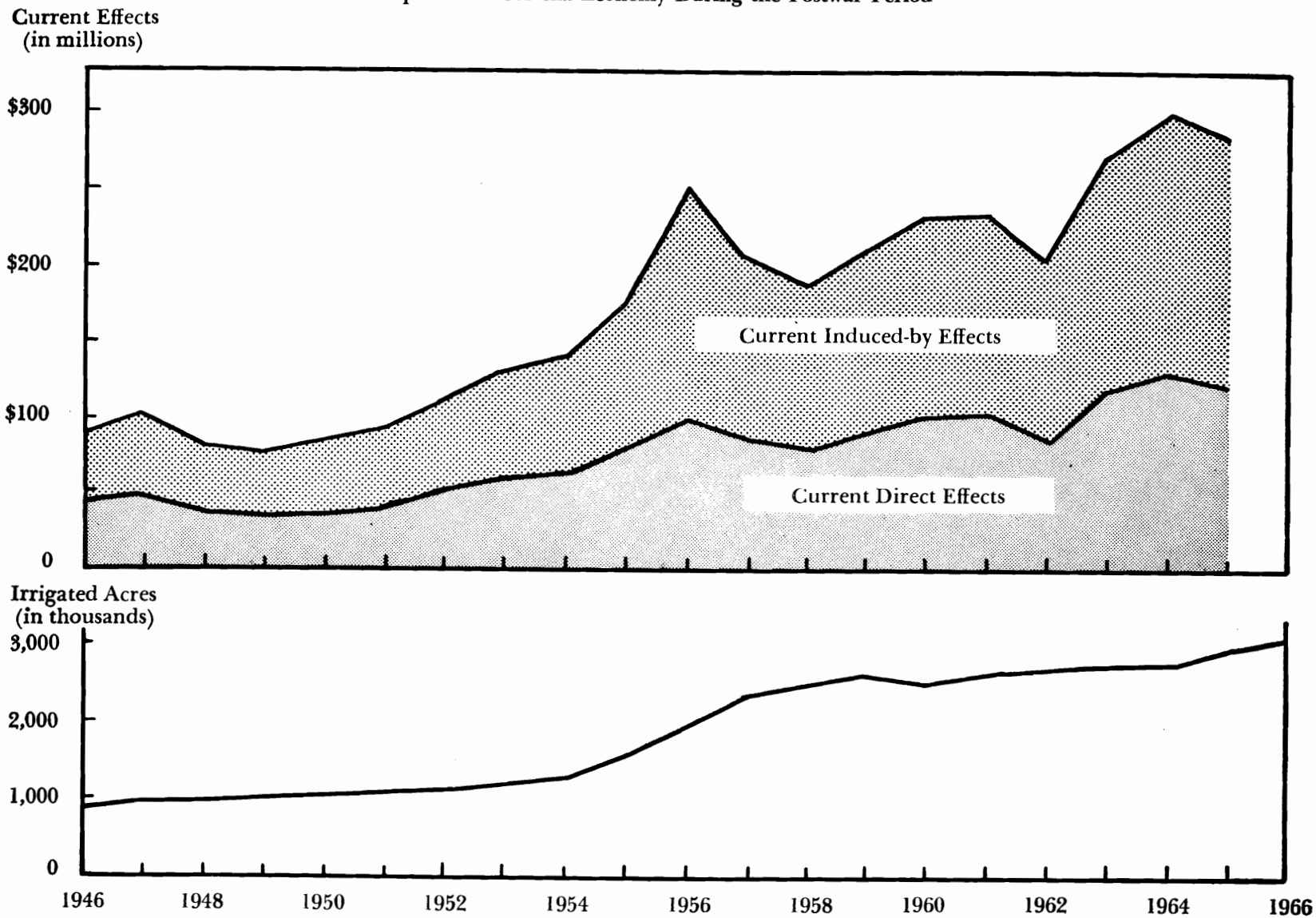
Source: The data were computed from those presented in Table 5.9.

It is also possible to express these sector impacts in terms of unit increases in irrigated output or in terms of a unit increase in irrigated acreage. This type of impact breakdown is presented in Table 1.2. The left-hand column of data shows the current induced-by effects on each Nebraska sector of an increase of $10,000 in net output of Irrigated Crops. As might be expected, Households show the biggest impact, experiencing increased income of over $5,200. This includes not only the increased personal income of farmers but also increases in the personal incomes of all persons engaged in supplying needed inputs to the Irrigated Crops Sector. The Real Estate and Trade Sectors experienced the next largest increases in transactions.[4] The total induced-by impact per $10,000 of net output of Irrigated Crops, shown at the bottom of the left

[4] There are no entries for the Crop sectors because the impacts on these sectors are direct, an increase in output for Irrigated Crops and a decrease for Dryland Crops combining to provide the net increase in output of $10,000. There is no current impact on Construction because all of the output of that sector is considered to move to Final Demand (investment).

CHART 1.2

Current Direct and Induced-by Effects of Irrigated Agriculture upon the Nebraska Economy During the Postwar Period



Source: State-Federal Division of Agricultural Statistics, *Nebraska Agricultural Statistics, Annual Reports,* 1946-1966, and Tables 5.1 and 5.3.

column, is approximately $12,900. This is a transactions total which, of course, includes some double-counting as the outputs of some sectors become inputs to other sectors.

The right-hand column of Table 1.2 shows the induced-by effects upon each sector per 100 acres of irrigated cropland. These sector impacts show the same relative relationship to each other as are exhibited in the left column. The total induced-by impact on the Nebraska economy per 100 acres is on the average $5,841. At this point the direct impact per 100 acres, which is $4,527, may also be of interest. Together the current direct and induced-by effects per 100 acres total $10,368.

The other type of impact resulting from the development of irrigated land is the investment impact. As noted in the discussion of the types of impacts, the estimation of the investment impacts presented special problems which for the most part prevented their estimation in this study. However, an examination of the direct investment impact of a hypothetical transfer of 10,000 acres of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector was undertaken. This involves a simulation technique and is discussed in Appendix A.

These direct investments refer to the capital improvements needed to provide and distribute the water supply used for irrigation and to any additional farm equipment needed because of the irrigation. The spending and respending activity in the Nebraska economy, associated with these investments is also included in the direct investment impact. An average cost pattern for the capital equipment in 1963 was assumed. The resulting total direct investment impact was estimated at approximately $7,123 thousand. This is the estimated volume of transactions generated in the Nebraska economy associated with the hypothetical transfer of 10,000 acres of cropland to the Irrigated Crops Sector. Expressing this on a per acre basis, approximately $712 of transactions are generated in the Nebraska economy as the direct investment impact when one acre of cropland is transferred from dryland to irrigation under the assumed conditions.

As illustrated in Appendix A, this same simulation approach lends itself to estimating the impacts of other specified changes on the state's economy. These impacts can also be broken down into the various sector impacts by way of input-output simulation.

METHODOLOGY

The methodology of impact measurement utilized in this study involved the use of relationships developed in an input-output analysis of the economy of Nebraska. Input-output tables were constructed because they permit a rather detailed examination of the relationships between the endogenous (internal) sectors of an economy and between these endogenous sectors and the sectors considered external to the regional economy. The basic input-output table, the transactions table, is a summary account of the many sales and purchase transactions that take place between all the major sectors of the economy under study. Other important tables are derived from the transactions table.

A very substantial part of the effort involved in this study was applied to the construction of input-output tables for the Nebraska economy for 1963. This year was selected because much information about the Nebraska economy in 1963 was available from the United States Bureau of the Census. A combination of secondary sources and industry surveys provided the basic data for the construction of the Nebraska Transactions Table.

The input-output tables developed for Nebraska in this study are presented in Appendix C and described in detail in Chapters III and IV. It will suffice for purposes of this summary to note the condensed transactions table for Nebraska for 1963 in Table 1.3. The internal economy of the state is here broken down into six sectors instead of the 23 sectors used in the tables of Appendix C. The Crops Sector of Table 1.3 is, for example, separated into Irrigated Crops and Dryland Crops in the tables used in this study. This was done to facilitate impact measurement. In so far as possible, emphasis was given to the delineation of sectors closely related to agriculture.

The Final Demand column shows the sales by the internal sectors to purchasers who use the product outside the internal economy as defined in this study. The more refined tables of Appendix C disaggregate Final Demand into five sectors. The Other Payments row shows the payments by the column sectors to sectors considered outside the internal economy, such as suppliers outside the state and government. Appendix C shows four Other Payments sectors.

As already noted, the Nebraska Transactions Table for 1963 may be used to study the sales and purchase patterns of the sectors of the Nebraska economy. Table 1.3 may be used to illustrate the interindustry transactions which are detailed in a transactions table. For example, the row designated Crops shows the sales of the Crops Sector to the other sectors of the Nebraska economy. Out of a

TABLE 1.3

Condensed Table of Input-Output Transactions for Nebraska, 1963

(Each cell shows the sale of output of the row sector to the column sector. The units are thousands of dollars.)

SELLING SECTORS (Internal Nebraska Sectors)	PURCHASING SECTORS (Internal Nebraska Sectors)							Total Out-Puts
	Live-Stock	Crops	Food Prod.	Mining & Other Mfg.	Other Business Sectors	House-Holds	Final Demand	
Livestock	150,647	12,745	619,625	0	82	16,766	45,336	845,201
Crops	121,053	12,809	132,998	0	180	2,934	427,623	697,597
Food Products	75,145	0	52,107	471	11,497	199,326	1,167,203	1,505,749
Mining & Other Mfg.	453	6,896	18,639	64,336	52,034	24,254	848,646	1,015,288
Other Business Sectors	119,440	175,766	132,149	90,168	461,844	1,334,252	1,411,829	3,725,448
Households	159,064	108,658	155,079	258,828	1,766,901	25,624	847,846	3,322,000
Other Payments	219,399	380,723	395,152	601,455	1,432,910	1,718,844	285,187	5,033,640
Total Inputs	845,201	697,597	1,505,749	1,015,288	3,725,448	3,322,000	5,003,640	16,145,850

Source: Condensed from Table C.1.

total crop output valued at $697.6 million, $427.6 million worth of crops—about 61 percent of the total—was sold to Final Demand, which in the case of Crops consisted mainly of exports from the state. Of the remaining 39 percent, most was sold to the Food Products (processing) and Livestock Sectors. A small amount was sold or kept for seed and a still smaller amount was sold to Households for consumption.

Table 1.3 permits one to follow the processing of the crops which occurs in the Nebraska economy. Turning first to the row for Food Products, an important customer of the Crops Sector, it is apparent that more than two-thirds of its output is sold to Final Demand, also chiefly exports. Thus, the crops which are sold to the Food Products Sector in the state usually leave the state as processed food products.

The Crops Sector also sells a substantial part of its output to the Livestock Sector. The Livestock row of Table 1.3 indicates that close to three-fourths of its output goes to Food Products (more specifically, to meat packing), which exports most of its products from the state. Thus, some crops move through two-stages of processing, the Livestock and Food Products Sectors, before moving to Final Demand.

The preceding discussion has illustrated how the rows of a transactions table may be used to follow the flow of goods from the producing sectors to the purchasing sectors. In a similar fashion the columns may be used to examine the purchases by a sector of its various requirements (inputs). Thus, the condensed Transactions Table for Nebraska indicates in the Crops column that over half of the purchases by the Crops Sector involved payments outside the Nebraska economy as defined for this study.[5] Most of the internal purchases indicated in Table 1.3 were from the Other Business and Household Sectors. Purchases from Households involve wages for hired labor and the income of the owner-operators of farms. These sectors, which are suppliers of the Crops Sector, in turn need to purchase inputs for their operations. Thus cycles of spending and respending may be traced out by use of the columns of the Transactions Table. The other types of basic input-output tables developed and used in this study will not be illustrated in this summary.[6]

Certain ratios or coefficients which are developed in input-output analysis are exceedingly useful for impact measurements. These three types of coefficients were particularly valuable: (1) the direct requirement coefficients, which for a given sector give its input requirements from the endogenous sectors per dollar of output; (2) the final demand multipliers, which for a given sector give its total requirements upon the endogenous economy per dollar of sales to Final Demand by the given sector; and (3) the output multipliers, which for a given sector give the total requirements upon the endogenous economy per dollar of output. For these coefficients, the requirements referred to are current input requirements, that is, those which are as-

[5] Other Payments include mainly taxes, depreciation, and imports. For further explanation of Other Payments, See Chapter III.

[6] For the Direct Requirements and Total Requirements Tables see Tables C.2 and C.3. For their interpretation see Chapter IV.

sumed to vary with changes in output. The capacities of the sectors (their fixed capital) are assumed to be adequate to accommodate the considered changes in output.

When using input-output tables, certain assumptions basic to the construction of the tables should be kept in mind. Technology, trade patterns (imports and exports), and relative prices are all assumed to be stable. Moreover, the average requirements described by the aforementioned coefficients are assumed to apply even as the outputs of the sectors change. Thus, while these coefficients have considerable usefulness for short-run analysis, their application to longer-run problems is limited.

Although the 1963 tables were considered to be a useful description of the economic structure of Nebraska in the 1960's, the multipliers resulting from the 1963 model were of questionable applicability to the early postwar years. For this reason, an attempt was made to adjust the Nebraska input-output tables for 1963 so as to reflect the Nebraska economy for 1947. In particular, the adjustments made emphasized the sectors which are important suppliers of the crop producing sectors.

From the revised tables for 1947, the multipliers for 1947 which were used in the impact analysis were obtained. The resulting estimates of the 1947 multipliers were somewhat below the 1963 multipliers. This, of course, is not unreasonable since the Nebraska economy of 1947 presumably supplied less of its own input requirements than that of 1963. Assuming that changes in the multipliers between 1947 and 1963 occurred in a linear fashion, the values of the multipliers of 1947 and 1963 were used to anchor a straight-line trend. By means of this linear trend, estimates of the multipliers for the period 1946 through 1965 were obtained. These multipliers made possible some estimates of the economic impact of irrigated agriculture on Nebraska's economy in the postwar period.

UNDERLYING ASSUMPTIONS

In interpreting the impacts indicated through input-output analysis, the various assumptions underlying the analysis should be kept in mind. In the first place, the sector definitions which apply to the basic input-output model are also pertinent to the sector impacts. Since the 1963 model for Nebraska was used in disaggregating the 1963 impacts, the relative price structure of 1963 and the technology and trade flows of that year are implied in the measurement of impacts of that year. Moreover, the assumption is being made that the average sales and purchase patterns of the various sectors apply also to increases in activity.

If these impacts for 1963 are used to estimate impacts of future changes in activity in Nebraska, the results should be interpreted with the above assumptions in mind. The various impact ratios developed in this study apply to the Nebraska economy. If used in connection with impact analysis in another state, the assumption that needs to be justified is that the underlying relationships which characterized the Nebraska economy in 1963 apply also to the other state in question.

CHAPTER II

BACKGROUND AND METHODOLOGY

Some familiarity with the economy of Nebraska will contribute to a better understanding of the analysis and measurement of impact as it was developed in this study. The salient economic features of the state are set forth in the first section of this chapter. Some comments on methodology follow in the second section.

THE NEBRASKA ECONOMY

The State of Nebraska is one of the states which form the section of the United States known as the Great Plains. It is in the North Central cluster of states, or more specifically, the West North Central cluster. With its 77,227 square miles of area, it ranks fifteenth among the states in land area.[1] It had a population of 1,411 thousand in 1960, ranking 34th among the states in this respect. Its per capita personal income in 1963 was $2,312, twenty-fifth among the states and 94 percent of the U. S. average of $2,449. Soil and water are the state's most important natural resources, and they form the basis for the dominant industry of the state, agriculture. Certain of its characteristics will now be examined in more detail.

Population Data

Table 2.1 presents some facts about the population of Nebraska. The 1960 population of 1,411 thousand represented a gain of 6.4 percent over the 1950 population. During this same period the population of the United States grew 18.5 percent.[2]

[1] The data presented in this paragraph were obtained from U.S. Dept. of Commerce, *Statistical Abstract of the United States, 1965*.

[2] The national data used here are from the same source as the data in Table 2.1.

TABLE 2.1

Nebraska Urban and Rural Population, 1950 and 1960

	1950		1960		Percent Change 1950 to 1960
	Number (1000's)	Percent of total	Number (1000's)	Percent of total	
Total Population[a]	1,326	100.0	1,411	100.0	6.4
Urban	622	46.9	766	54.3	23.2
Rural	703	53.0	646	45.8	- 8.1
Nonfarm	312	23.5	337	23.9	8.0
Farm	391	29.5	309	21.9	-21.0
Population per square mile	17.3		18.4		

[a] Parts may not sum to total due to rounding errors.
Source: U. S. Department of Commerce, *Statistical Abstract of the United States, 1965*, pp. 13 and 16.

The slower growth rate for the Nebraska population may be better understood by examining the urban-rural breakdown of the state. The data suggest that most of the growth of the urban and rural nonfarm categories was at the expense of the farm population. While the percentage which the farm population is of the state total changed from 29.5 percent to 21.9 percent over the ten year period, the corresponding percentages for the urban population increased from 46.9 to 54.3. The percentage in the rural nonfarm category was relatively stable.

In spite of these changes, Nebraska is still agriculturally oriented in contrast to the nation. Only 7.5 percent of the national population was on farms in 1960, compared with 21.9 percent for Nebraska. Nebraska's urban percentage of 54.3 was low in comparison with 69.9 percent for the nation.

Industry Composition

Some insights into the industrial structure of the Nebraska economy may be gained by examining employment data for broad industry groups. Such data along with some industry percentages are presented in Table 2.2 for the years 1950 and 1963. 1950 is the first year for which all the data were

TABLE 2.2

Nebraska Employment by Industry,[a] 1950 and 1963

	1950 Employment		1963 Employment		Percent Increase in Employment 1950–63	
	Number (1000's)	Percent of total	Number (1000's)	Percent of total	Nebraska	U.S.
Total[b]	590.6	100.0	618.0	100.0	- 4.6	15.2
Agriculture	197.4	33.4	143.7	23.3	-27.3	-35.1
Trade	85.2	14.4	98.3	15.9	15.4	25.8
Government	61.1	10.3	84.7	13.7	38.6	52.7
Manufacturing	52.1	8.8	66.5	10.8	27.6	11.6
Services	42.3	7.2	61.2	9.9	44.7	52.9
Transportation, Commun., & P. U.	41.1	7.0	36.8	5.9	-11.6	- 3.0
Construction	19.0	3.2	24.7	4.0	30.0	27.8
Fin., Ins., & R. E.	17.4	2.9	24.4	3.9	40.2	49.7
Mining	1.1	0.2	2.1	0.3	90.9	-29.6
Other Non.-Ag.	73.9	12.5	75.6	12.2	2.3	2.7

[a] The data for agriculture are somewhat more inclusive than the data for the other industries, in that they include hired workers, farm owners, farm operators, and unpaid family workers. For the other industry groups, proprietors, self-employed, unpaid family workers, and domestic workers are not included, but are included in other nonagricultural employment. Moreover, the nonagricultural employment data are based on reports by establishments. Since a few persons work for more than one establishment, there is a small unmeasured amount of double-counting in these data.

[b] Parts may not sum to total due to rounding errors.

Source: The basic Nebraska data were obtained from the Nebraska Department of Labor and the basic national data were obtained from the U. S. Dept. of Commerce, *Statistical Abstract of the United States, 1967*. The percentages were computed from the basic data.

available for the breakdown utilized. 1963 is the year for which an input-output model was constructed. In spite of some data deficiencies referred to in the footnote to the table, it should indicate the broad outlines of the Nebraska industrial structure and some of its dynamic characteristics in the postwar period.

Table 2.2 ranks the industries in order of size of employment with the catch-all category of other nonagricultural employment given last. All the categories given in the table showed increases in their relative shares of the total except agriculture; transportation, communications, and public utilities; and other nonagriculture. The most pronounced decrease occurred in agriculture. All the categories experienced absolute increases except agriculture and transportation, communication, and public utilities.

Although the employment rankings did not change during this period, the differences between some positions changed substantially, notably that between agriculture and trade. Since trade may well include many proprietors, self-employed, and unpaid family workers who are in the category of other nonagricultural employment,[3] trade is without much doubt underestimated here. Thus the employment in retailing and wholesaling may be approaching that in agriculture. For the same reason given for trade, the employments in finance, insurance, and real estate and in services are probably underestimated.

The two columns on the right side of Table 2.2 compare the percentage changes of the Nebraska industries with their national counterparts during the 1950 to 1963 period. Overall employment in Nebraska increased much less than in the United States as a whole, reflecting mainly the declining employment opportunities afforded in agriculture. However, the rate of decrease in Nebraska agriculture was much less than the national rate for agriculture. Mining showed a tremendous percentage increase in Nebraska, but since it is such a small part of the total, its influence on the aggregate percentage rate is minimal. As one might expect, most of the industries showed percentage increases below those of the national industries. However, construction's increase was somewhat above the na-

[3] On the other hand, such workers are included in agricultural employment as footnote (a) to Table 2.2 indicates.

TABLE 2.3

Employment in Selected Manufacturing Industries, Nebraska Compared with the United States for Selected Years

	1950		1958		1963	
	Nebraska	U.S. (1000's)	Nebraska	U.S. (1000's)	Nebraska	U.S. (1000's)
Manufacturing	52,100	15,241	60,000	15,945	66,500	16,995
Food Products[a]	29,100	1,790	28,400	1,773	27,500	1,752
Meat	15,200	296	14,700	319	12,900	316
Dairy	3,500	n.a.	3,200	319	3,100	294
Grain Mill	3,300	n.a.	3,400	132	3,600	130
Other	7,000	n.a.	7,100	1,002	7,900	1,011
Chemicals	1,000	640	1,800	794	2,200	865
Metals	2,900	2,229	4,600	2,230	5,200	2,322
Machinery and Equipment	4,900	3,466	9,700	4,206	13,700	4,693
Other Manufacturing	14,200	7,116	15,500	6,942	17,900	7,363

[a] Parts may not sum to subtotal due to rounding errors.
Source: The Nebraska data were obtained from the Nebraska Department of Labor and the national data from the U. S. Bureau of Labor Statistics, *Employment and Earnings Statistics for the United States*, 1909–65.

TABLE 2.4

Relative Shares of Manufacturing Employment in Selected Industries, Nebraska compared with the United States for Selected Years

	1950		1958		1963	
	Nebraska	U.S.	Nebraska	U.S.	Nebraska	U.S.
Manufacturing[a]	100.0%	100.0%	100.0%	100.0%	100.0%	100.0
Food Products[a]	55.8	11.7	47.3	11.1	41.4	10.3
Meat	29.2	1.9	24.5	2.0	19.4	1.9
Dairy	6.7	n.a.	5.3	2.0	4.7	1.7
Grain Mill	6.3	n.a.	5.7	0.8	5.4	0.8
Other	13.4	n.a.	11.8	6.3	11.9	6.0
Chemicals	1.9	4.2	3.0	5.0	3.3	5.1
Metals	5.6	14.6	7.7	14.0	7.8	13.7
Machinery and Equipment	9.4	22.7	16.2	26.4	20.6	27.6
Other Manufacturing	27.3	46.7	25.8	43.5	26.9	43.3

[a] Parts may not sum to total or subtotal due to rounding errors.
Source: The basic data from which the percentages were computed are presented in Table 2.3.

tional rate and Nebraska manufacturing's rate of increase was 27.6 percent compared to a national rate of 11.6 percent.

A further breakdown of manufacturing is provided in Tables 2.3 and 2.4. Both tables present employment data for selected components of manufacturing which are either the most important categories in Nebraska because of their size or are of particular interest in this study as suppliers of agriculture or as processors of agricultural products. Corresponding national data for the same components are presented for comparison purposes. Since data for certain national components were not available for 1950, data for the earliest year for which they were available, namely 1958, were included.

Table 2.3 presents the numbers employed in the various categories and Table 2.4 gives the percentages which the components are of their respective *manufacturing employment* totals. It should be emphasized that the percentages in Table 2.4 are not comparable to the percentages in Table 2.2 since the latter were computed with respect to *total employment.*

It is apparent from Table 2.3 that the substantial percentage increase in manufacturing employment in Nebraska, noted in Table 2.2, is not due to increased employment in food processing. While such employment has declined somewhat in the aggregate, two components, grain mill processing and other food processing, have shown some increases. The national pattern in employment in food processing has been one of near stability or very gradual change.

The other types of manufacturing, however, have shown very substantial employment increases from a high of 179.6 percent for machinery and equipment to a low of 26.1 percent for other manufacturing. It is apparent from the data that these other types of Nebraska manufacturing have increased by much higher percentages than their national counterparts. While a substantial part of this activity is related to supplying agriculture, such as the manufacture of irrigation pipe and pumps, some of the activity is not closely related to agriculture.[4]

Table 2.4 shows the relative shares of total manufacturing employment found in the various types of manufacturing in Nebraska and in the United States. Again the 1950 situation may be compared with 1958 and 1963. As would be expected, employment in the manufacture of food products is relatively much more important in Nebraska than in the United States. However, the Nebraska percentage has declined substantially in the postwar period. And the components of food product manufacturing have declined in their relative shares over the entire period.

The relative shares of manufacturing employment in the other types of manufacturing are substantially lower in Nebraska than in the nation. Table 2.4 indicates, however, that the employment share attributable to machinery and equipment manufacturing in Nebraska has more than doubled in the postwar period. This percentage, 20.6 percent in 1963, has been increasing more rapidly than the corresponding national percentage.

At this point, one could examine certain other Nebraska data for which some industrial disaggregation is available[5] and perhaps note some additional details about the economic structure of the state. However, the employment data just examined offer the most detailed breakdown available on a continuing basis and describe the general economic structure adequately for the purpose at hand. Because of the nature of this study, some further attention should be given to agriculture in Nebraska.

Nebraska Agriculture

Nebraska is one of the most important of the agricultural states. With its diversified production it ranks first among the states in the production of alfalfa meal, wild hay, and Great Northern beans. The state ranks second in grain-fed cattle marketed and in commercial livestock slaughtering. It is in third place with respect to grain sorghum production, grain storage capacity, and total cattle inventories. Its creamery butter production and wheat production rank fourth, its corn production and sheep feeding fifth, and its hog production sixth.[6]

Chart 2.1 shows the pattern of cash receipts from farm marketings over the postwar period. While Nebraska ranks high in feed production, much of this is fed to livestock with the result that cash receipts from livestock marketings have been substantially higher than receipts from the sale of crops—for about half of the period over twice as high.

One of the important developments affecting crop production in Nebraska in the postwar period is the rapid growth of irrigation. Between 1945 and

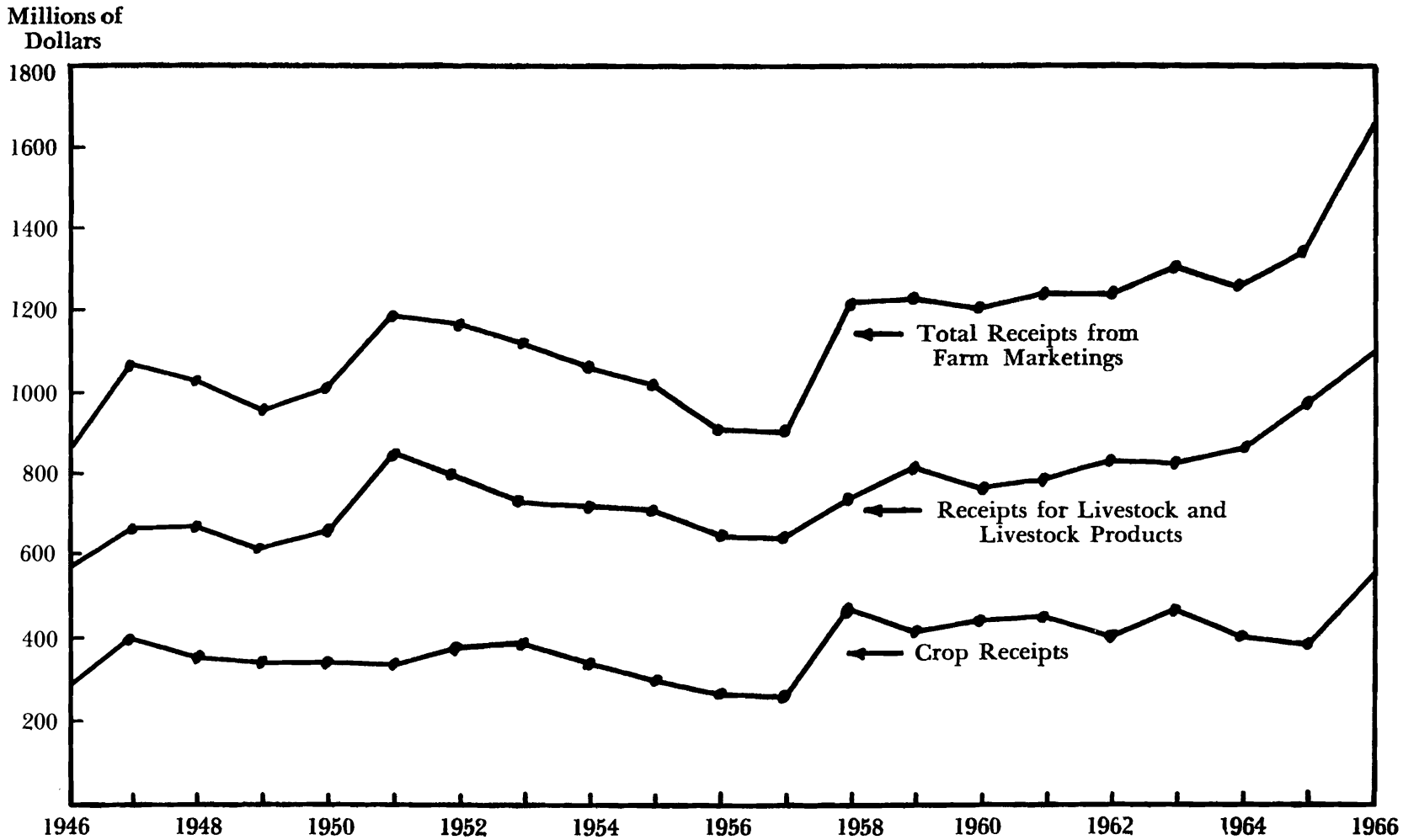
[4] Data from the *Census of Manufacturers* do not indicate how much of the increased manufacturing employment is clearly related to agriculture. This would be an appropriate subject for further study.

[5] E.g., participation income and value added.

[6] State-Federal Division of Agricultural Statistics, Lincoln, Nebraska. Rankings apply to 1967.

CHART 2.1

Cash Receipts from Farm Marketings in Nebraska, 1946-66



Source: State-Federal Division of Agricultural Statistics, *Nebraska Agricultural Statistics, Centennial Edition,* 1967, p. 15.

TABLE 2.5

The Five States with the Greatest Number of Irrigated Acres in 1964 and their Growth in Irrigated Acres since 1945

	Number of Irrigated Acres		Percent Increase 1945 to 1964
	1964	1945	
California	7,598,698	4,952,819	53.4
Texas	6,384,963	1,320,216	383.6
Idaho	2,801,500	2,027,280	38.3
Colorado	2,690,018	2,698,519	-0.3
Nebraska	2,169,317	631,762	243.4

Source: *1964 Census of Agriculture*, Vol. 1, State Reports.

1964 the number of acres irrigated increased from 631,762 to 2,169,317 as indicated in Table 2.5.[7] This 243.4 percent increase is equivalent to an average growth of 6.7 percent per year. This growth rate is second highest among the states and places Nebraska fifth among the states in the number of acres under irrigation.

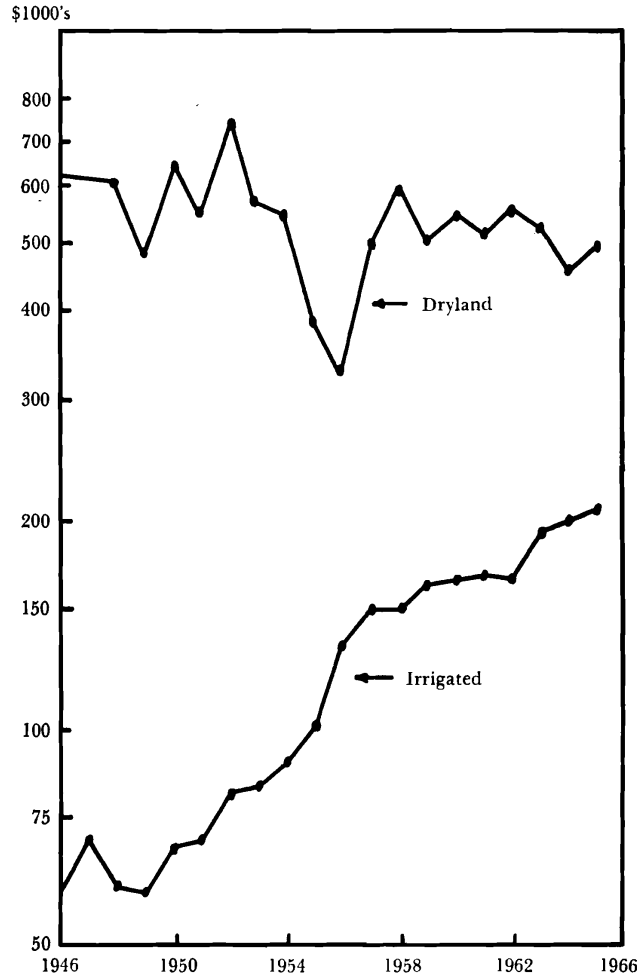
While Nebraska has a number of reservoir-supplied irrigation systems, much of the postwar increase in irrigation has been due to the development of wells which supply groundwater for irrigation. Under much of Nebraska's farmland is a large supply of underground water which is being increasingly tapped for irrigation purposes. The number of registered irrigation wells has grown from 11,685 in 1955 to 25,803 in 1965, an increase of 120.8 percent.[8] As of January 1, 1965, only one county in Nebraska was without a registered well and only 25 counties had less than 25 wells.[9]

The chief crops grown on irrigated farm land in Nebraska are corn, sorghums, and alfalfa hay. In contrast to some western states where irrigation has encouraged diversified crop production with an increase in specialty crops, Nebraska has not experienced a development of specialty crops to the same degree. The state's location in relation to major population centers accounts in part for this. Chart 2.2 shows how the value of Nebraska's irrigated crop production compares with the value of its dryland crop production in the postwar period. Whereas in 1946 the irrigated crops had a value slightly under one-tenth that of dryland crops, by 1965 this fraction had increased to somewhat over four-tenths.

Since this chart is on ratio paper, the slopes of the lines may be used to compare percentage rates

CHART 2.2

Value of Nebraska Crop Production on Dryland and Irrigated Land, 1946-65



Source: Same as for Table 5.1.

of change. The value of the irrigated production grew most rapidly between 1949 and 1957. Since then the rate of growth has slackened some. It is also quite apparent from Chart 2.2 that crop production on irrigated land is much more stable than that on dryland. This stability is, of course, a major advantage of irrigated farming.

It is the impact of the increased crop production due to irrigation with which this study is concerned. The next section will briefly consider the methodology for measuring impact.

THE METHODOLOGY OF IMPACT MEASUREMENT

A number of methods have been used in attempting to measure the economic impact of irrigation. One of these is the method of area comparisons.[10] In this approach, a subject area is compared with a comparison area. Ideally, the two areas should be

[7] Data on irrigated acres reported by the *Census of Agriculture* are used in Table 2.5 to permit interstate comparisons. At other places in this report, data presented in *Nebraska Agricultural Statistics, Annual Reports* are used. The two estimates differ somewhat because of several problems involved in estimating the number of irrigated acres and because of different estimating procedures.

[8] *Ibid.*, p. 9.

[9] State-Federal Division of Agricultural Statistics, *Nebraska Agricultural Statistics, Annual Report, 1963*, pp. 76–77.

[10] See these studies by the Bureau of Reclamation of the U.S. Department of the Interior: *Accomplishments of Irrigation, Weld County, Colorado, 1952*, and *Economic Changes in the Arkansas Valley in Colorado During the 1950's*, 1961.

very similar except for the presence in one and the absence in the other of an irrigation project. After some lapse of time any differences exhibited are attributable, hopefully, to irrigation. While this method may be helpful in studying small regions, it does not appear feasible for an area of the size of Nebraska since a suitable comparison area is not available. Some effort was directed toward identifying a group of counties with very substantial irrigated acreages within the state and a corresponding comparison group with little or no irrigation. The problem of keeping other things except irrigation equal was not overcome. Moreover, even if such a comparison could be made for two groups of counties, any ratios developed would have limited usefulness when applied to a larger region because the indirect effects tend to increase as the size of the region increases.

A popular method of estimating economic impact in recent years is the economic base study.[11] It has been used in general regional analysis and also in studies of the impact of irrigation.[12] This approach involves a division of a local economy into two segments: (1) The firms and individuals serving export markets and (2) the firms and individuals serving local markets. The first group is considered the basic group. Increases in its size are alleged to be the main source of growth in the local economy. The second group is referred to as nonbasic or derivative.

The activity of the basic and the derivative groups may be measured in terms of income or employment, though the latter is usually used because of the greater availability of employment data. A ratio of derivative activity to basic activity is then computed. To illustrate, if an employment ratio of 2 to 1 is obtained, this means that for every employee in a basic activity there are 2 employees in nonbasic activities. Or the ratio of total activity to basic activity may be used. Using the illustration just given, the ratio of total to basic activity would be 3, or for each employee in a basic activity, there would be on the average 3 employees all told. This later ratio is referred to as the employment multiplier.

In its simpler forms, economic base analysis usually developes one multiplier for the basic group of industries. Thus it involves excessive aggregation. In reality the various industries may differ substantially in their multiplier effects, as noted in Chapter IV of this study. Furthermore, short-run effects on current production and long-run effects by way of investments are all lumped together in the one multiplier. Thus much detail about the operation of the multiplier is concealed.

Economic base studies can be designed to provide more detail about the interindustry relations in the economy. As the design becomes more complex, it approaches an input-output model of the economy. Such a model shows the internal functioning of the economy and its relations with the external economies in considerable detail. While input-output analysis has much larger data requirements and is therefore a more costly research method, it is the most efficient tool for analyzing interindustry relationships. It depends less on restrictive assumptions than does the usual base study and it develops a multiplier for each industry. Because of its advantages it is the approach to impact measurements used in this study.

Input-output analysis is best adapted to measuring current impacts on productive activities. Three types of current impacts of irrigation will be estimated in this study: (1) The net increase in crop production and gross farm income due to irrigation; (2) the effects of the spending and respending of this increase in farm income; and (3) the economic activity which develops out of the local handling and processing of the crops before they leave the domestic economy.

Increased current activity may also generate investment activity. Consideration will also be given to the estimation of investment impacts. However, special data problems make this type of impact measurement more difficult.

An input-output model of the Nebraska economy was constructed for the year 1963. This year was chosen because it is the year of the most recent *Census of Manufactures* and *Census of Business*. The 1963 model is the chief measurement tool in the study. In addition, a partial model for 1947 was constructed in rough form to aid in estimating some of the economic impact of irrigation for the first part of the postwar period.

Before the impact estimation procedure can be described, the Nebraska model for 1963 needs to be explained and interpreted. These are the objectives of Chapters III and IV.

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[11] An excellent discussion of economic base analysis is contained in Charles M. Tiebout, *The Community Economic Base Study*, Suppl. Paper No. 16, New York, Committee for Economic Development, 1962.

[12] See, e.g., Helmer C. Holje, Roy E. Huffman, and Carl F. Kraensel, *Indirect Benefits of Irrigation Development*, Bulletin 517, Montana State College Agricultural Experiment Station, March 1956; also, Arlyn J. Larson and William E. Koenker, *Estimated Indirect Benefits from Irrigation in North Dakota*, North Dakota Economic Studies No. 6, Univ. of N. D. Bureau of Business and Economic Research, February 1961.

CHAPTER III

CONSTRUCTING THE NEBRASKA INPUT-OUTPUT MODEL

The primary objective of the study was to measure the direct and indirect impact of irrigated agriculture on the Nebraska economy. To this end, an input-output model was considered the best analytical model to provide quantitative measures of the economic impact of this sector.

The purpose of this chapter is (1) to discuss input-output analysis and the construction of the Nebraska Input Model, (2) to define the sectors used in the Nebraska Input-Output Model, and (3) to discuss methods and sources of information used in estimating inter-sectoral transactions.

INPUT-OUTPUT ANALYSIS

Input-output analysis is based on the idea that a large portion of the effort of an economy is devoted to the production of intermediate goods, and the output of intermediate goods is closely linked to output sold to final demand. An increase in the final demand of any product (say exports from irrigated agriculture) implies changes in the outputs of the intermediate goods (fertilizer, fuel, seed, etc.) used in producing that product and, indeed, changes in the output of goods used in producing these intermediate goods, and so on.

To depict the various interrelationships of an economy for a specified period, a transactions table is constructed. This table is generally referred to as an interindustry transactions table, or as an intersectoral transactions table, and is a summary account of the many sales and purchase transactions that take place between all the major sectors within the economy.

A common feature of an input-output model is the delineation between endogenous and exogenous transactions. The former are transactions between the producing sectors of the economy and are sometimes referred to as internal. The volume of these transactions is determined by the model for a given level of final demand.

Exogenous transactions include all transactions between the producing sectors and the sectors external to the model. Some of these exogenous transactions are sales to final demand which include, for example, investment demand and exports. Such transactions are not closely related to the current level of output of the economy's sectors. Other exogenous transactions involve those types of payments which are not closely related to the level of output or which involve money leaving the economy. Examples of such payments are taxes, depreciation, and imports. These distinctions will become more apparent in the discussion of the Nebraska Model.

The various flows of goods and services summarized in the transactions table can also be expressed as a system of equations. The number of equations in the system depends on the number of endogenous sectors. From the system of equations, input coefficients (direct requirements) and interdependence coefficients (total direct and indirect requirements) can be computed. The meaning and use of these coefficients will be explained in the next chapter. At this point it will suffice to note that they are useful in measuring economic impact.

An input-output model can be designed to depict inter-sectoral relationships: (a) within a national economy; (b) within a regional economy; or (c) within and between regional economies. The type of input-output model used depends largely on the situation being studied. To measure economic impact for a region, a regional input-output model is most appropriate. This model emphasizes the interrelationships of economic activity within the region. Commodity and resource flows between the region and the rest of the nation as well as the world can be shown as sector exports and imports.

THE BASIC FEATURES OF THE MODEL

The regional input-output model was used because this study was mainly concerned with the inter-sectoral relationships for Nebraska. Transactions between Nebraska sectors and those located outside of the state were treated as imports and exports. Table 3.1 illustrates the basic design of the Nebraska Inter-Sectoral Transactions Table constructed for 1963. The major parts of the Nebraska model are indicated on the table. The cell configuration in the upper left hand corner illustrates the many cells which make up the body of the table. These cells are used to record data which can be interpreted either as sales transactions or

TABLE 3.1

The Endogenous and Exogenous Parts of the Transactions Table

SELLING SECTORS		PURCHASING SECTORS: Internal Sectors						External Sectors (Final Demand)				Total
		Agricultural Sectors	Mining	Manufacturing Sectors	Non-commodity Sectors	Construction	Households	State-Local Gov't	Fed. Gov't	Private Capital Formation	Net Change in Inventories	Exports	
Internal Sectors	Agricultural Sectors												
	Mining												
	Manufacturing Sectors												
	Non-commodity Sectors												
	Construction												
	Households												
External Sectors (other payments)	State-Local Government Federal Government Depreciation Imports & Other Expenses												
	Total												

endogenous transactions

exogenous transactions

exogenous transactions

as purchase transactions. Reading across a row indicates sales by the row sector to the various column sectors. Reading down a column shows purchases by the column sector from the row sectors.

One of the chief problems in constructing the Nebraska Input-Output Model dealt with the choice of the particular set of sectors (both endogenous and exogenous) to be used. The development of the classification system used in this study was conditioned to a large extent on the importance of each sector's distribution and purchase pattern with irrigated agriculture. Other criteria such as the similarity of distribution patterns, similarity of input patterns, disclosure problems, and the form and type of available data were considered in aggregating establishments into sectors.

The upper left hand part of Table 3.1 contains the transactions of the endogenous sectors of the model. The sectors that comprise the endogenous part of the table are: (1) the agricultural sectors, (2) mining, (3) the various manufacturing sectors, (4) the non-commodity sectors, (5) construction, and (6) households. In general, these are sectors whose levels of activity are not autonomously determined but depend mainly on the level of final demand.

The final demand and the other payments sectors comprise the exogenous portion of the transactions table. The right hand part of the table shows the five column sectors which constitute the final demand part of the model. The purchases shown in these final demand columns are considered to be determined largely by forces outside the internal economy. While consumption expenditures are often included under final demand, they were not so included in the model used here. Rather a Households Sector was included in the endogenous part of the model so that the measurement of impact would include additions to personal income and the increased spending resulting therefrom.

The other payments sectors are also considered as exogenous. The lower portion of the transactions table shown in Table 3.1 includes the payments for materials and services which are not considered endogenous to the regional economy. Payments for imports include both purchases of materials used up in production by the endogenous sectors and the purchases of finished goods by the final demand sectors. Taxes, also an exogenous payment, are treated as a payment for services provided by governments.

When examining the columns of a transactions table, it should be kept in mind that for the endogenous sectors the purchases reflect the requirements necessary to maintain the level of production shown in output totals (both column and row totals). These requirements reflect both the existing technology in use in the economy and the flow of imports necessary to supply the endogenous sectors. On the other hand purchases by the final demand sectors reflect only expenditure patterns and are not determined by the model.

Available data are crucial to the construction of any input-output model. Ideally, the use of published statistics would be the most efficient and least expensive way of constructing a transactions table. Unfortunately, a dearth of economic information on the Nebraska economy has handicapped the construction of the Nebraska model—a predicament not unusual in this type of study. While Nebraska industry output totals were available for many of the sectors from the U.S. Bureau of the Census, there was very little published material on transactions between the sectors. As a result detailed interviews were conducted utilizing samples of the establishments in the manufacturing sectors and in others. Utilizing both these primary data and the available published statistics, the Nebraska Input-Output Model for 1963 was constructed. Tables B.2 and B.3 summarize the sources of information used in the construction of the model.

SECTOR DESCRIPTIONS

All productive activities of the Nebraska economy were grouped into twenty-three sectors. In addition, final demand was divided into five sectors (including exports) and other payments consisted of four sectors (including imports). A summary of sector descriptions along with output totals is given in Table B.1.

To a large extent the Standard Industrial Classification System was used to classify establishments into sectors. Where other methods or modifications were used, this is pointed out in the following discussion and in Table B.1.

Agriculture

For constructing the 1963 Nebraska Inter-Sectoral Transactions Table, agriculture was defined to include three sectors: (1) Livestock and Livestock Products, (2) Irrigated Crops, and (3) Dryland Crops. Agriculture was defined in this way so that the input-output model could be used to measure the economic impact of irrigated agriculture on the Nebraska economy.

The total value of output for each of the agri-

cultural sectors was defined on a commodity rather than on an establishment basis. The output totals cover values of farm production for open market sale, for placement under loan with the Commodity Credit Corporation, for farm inventory accumulation, and for farm home consumption. The output totals also include certain transactions which are usually netted from the regularly published farm income and production statistics. These transactions cover nonpurchased feed and seed, manure, and livestock. The receipts for custom work and the production of commercial seed were considered a part of the Irrigated and Dryland Crops Sectors. This was necessary from the standpoint of the farm production expenses recorded in published farm income and production statistics. These expenditures reflect all expenses—farm commodity production, custom work, and commercial seed production done on a contract basis with seedhouses.

The output totals do not include the cash subsidies paid directly to the farmers or the gross rental value of farm dwellings. Direct government subsidies were handled as a payment from the Federal Government to Households in the Federal Government column and the Household row of the transactions table. Gross rental value of farm dwellings was considered as a part of Real Estate and Rentals.

Livestock and Livestock Products. Included in this sector were all meat animals, poultry, eggs, milk and butterfat, wool, and beeswax and honey produced in Nebraska. A secondary product, manure, was also included in this sector.[1]

Pasture was considered as a part of the Livestock and Livestcok Products Sector. The value of pasture was considered implicit in the production of Livestock and Livestock Products and was reflected in the payments to Households.

Irrigated Crops. The primary products included in this sector were the food and feed grains, sugar crops, all hay and other roughage (excluding pasture), legume and grass seeds, and minor crops produced on irrigated land. The commercial production of seed was also included. A secondary product, custom work, was considered as a part of this sector.

Dryland Crops. The primary products included in this sector were the food and feed grains, all hay and other roughage (excluding pasture), legume and grass seeds, and minor crops produced under dryland conditions in Nebraska. The commercial production of seed grown under dryland conditions and custom work were considered a part of this sector.

[1] This practice was also followed in constructing the national tables for 1958.

Mining

The mining sector was defined to include the extraction of minerals, crude petroleum, natural gas, and natural gas liquids. Also included were quarrying, milling and other mining activities located within the state.

The output of this sector was measured in terms of value of production. The main activities in this state were crude petroleum wells and quarrying of sand and gravel.

Manufacturing

The various manufacturing establishments located in the state were aggregated into ten manufacturing sectors. Sector titles along with S.I.C. codes and brief descriptions are given in Table B.1. Greater disaggregation of a few of the sectors might have been desirable for future studies, but the problem of available data and disclosure precluded this. The level of aggregation used, however, should not affect the conclusions of the study.

The gross value of output for each of the manufacturing sectors was measured in terms of value of shipments. Total estimated value of shipments for each sector were determined from published and unpublished Census information (see Table B.1).

To define the sectors and to group manufacturing establishments into the appropriate sector, the Standard Industrial Classification System was used. However, one modification was made in using the S.I.C. system. For the S.I.C. two-digit group twenty-seven (printing, publishing, and allied industries), the portion of revenue derived from advertising was not included in Other Manufacturing, but was considered a part of the sector called Services (see Table B.1).

Non-Commodity

The sectors classified as non-commodity are those which provide various types of services. These sectors are readily distinguishable from the commodity producing sectors.

Trade. Trade was defined to include those establishments which sell goods at the wholesale and/or retail level. Output was measured in terms of gross margins which are sales less cost of goods sold. Goods purchased for resale were therefore excluded from both the distribution of output and expenditures.

The Trade Sector row of the Nebraska Transactions Table reflects buyers of goods and services paying the trade margin. For example, Irrigated Crops is paying a margin to Trade for the purchase of materials sold within Nebraska.

Finance. The Finance Sector was defined to include banking, credit agencies other than banks, and securities brokers and salesmen. Banking includes those institutions which are engaged in deposit banking or closely related functions, including fiduciary activities. These include commercial banks and trust companies.

Credit agencies other than banks comprise establishments engaged in extending credit in the form of loans but not engaged in deposit banking. This includes savings and loan associations, federal land bank associations, credit unions, co-operative credit associations, industrial loan and investment companies, and licensed lenders.

Security brokers and salesmen are those individuals and establishments primarily engaged in the purchase, sale, and brokerage of securities on their own account or for the account of others.

The output of this sector was measured in terms of operating revenues. These revenues include interest on securities and loans, service charges, fees, commissions, and other current operating revenues.

Insurance. This sector is composed of carriers and agents of life and nonlife insurance. Life insurance was defined to also include accident and health insurance and annuity insurance. Nonlife insurance is composed mainly of fire, marine, and casualty insurance as well as all other types of insurance.

Output of life insurance companies with home offices in the state was valued in terms of underwriting and investment operating expenses. Output of domestic nonlife companies was valued as premiums received less benefits or losses paid. Output of companies with home offices located in other states was valued in terms of commissions paid on Nebraska business to agents within the state.

Real Estate and Rentals. This sector is composed of (1) real estate agents and brokers and (2) owners and lessors of real property. Output of real estate agents and brokers was valued in terms of business receipts. Output also included gross rents paid by Nebraska residents on all real property, whether paid to businesses, governments, or persons, and the imputed gross rental value of owner-occupied farm and nonfarm dwellings.

Transportation and Warehousing. The Transportation and Warehousing Sector is composed of railroads, railway express services, freight, passenger, water, air, and pipline transportation. Warehousing was included to the extent that it is performed by these activities. The output of these transportation activities was measured in terms of operating revenues earned within the state.

Railroad transportation includes the Nebraska business of five major railroads and two local railroad companies. Railway express services are those allied to rail transportation. Freight transportation is composed of motor carriers of property which have for-hire operations within the state. Passenger transportation is composed of taxi cabs, intercity, and city and suburban motor carriers of passengers.

Water transportation is composed of services provided primarily on the Missouri River. Air transportation includes services by domestic air carriers but excludes local airports and services. Pipeline transportation includes companies engaged in the transmission of crude or refined petroleum. Pipeline transmission of natural gas is included in the utilities industry.

In general, the purchaser of a product was treated as buying the transportation services involved in its delivery. An exception to this rule occured in the treatment of the agricultural sectors in which case farmers were considered as paying for the transportation of their products to the first point of delivery.

Utilities. This sector is composed of electric and gas companies, water and sanitation systems, telephone and telegraph, and radio and television broadcasting. Publicly owned utilities were transferred from the State and Local Government Sector to this industry. Establishments providing paging and answering services were excluded from telephone and telegraph and were included in the Service sector.

Output of each of the activities included in this industry was valued in terms of current operating revenues. These revenues were adjusted to exclude receipts from sales for resale by the gas and electric companies.

Services. This sector is composed of those establishments engaged in rendering a wide variety of services to individuals and business. It includes hotels and other lodging places; personal, business, repair, and amusement services; legal, engineering, and other professional services; and medical, educational, and nonprofit institutions. Publicly owned schools and hospitals were transferred from the State and Local Government Sector to this sector. Offices of veternarians were also included in this sector.

The valuation of output was expressed in terms of business receipts except for hospitals, education, and nonprofit organizations. Output of these activities was defined in terms of current operating expenditures.

Construction

This sector is composed of three broad types of construction activity: (1) building construction by general contractors; (2) other construction by general contractors; and (3) construction by special trade contractors. The term construction refers to new work, additions, and alterations which were charged to capital accounts. Repair and maintenance construction is therefore excluded from this sector. Output was measured in terms of value put in place within the state.

Households

This sector refers to the sales of labor and other services to the various sectors of the economy and to final demand. In addition to labor the households supply land, capital, and entrepreneurial services, and receive rent, interest, dividends, and the profits of unincorporated businesses. Transfer payments were also included in the revenues of this sector. It will be recognized that these payments make up the personal income of the households of the state. The Household row of the transactions table shows the personal income flows to Households from the endogenous sectors and from Final Demand.

The personal income total used here reflects certain adjustments to the total personal income of Nebraska for 1963 as estimated by the U.S. Department of Commerce. In the first place, the Department of Commerce estimate excludes personal contributions for social insurance, but these were included in the total used here. Secondly, imputed interest was not included in the total used, though it is in the Department of Commerce estimate. These adjustments (in millions) are shown as follows:

Dept. of Commerce estimate of Nebraska personal income	$3,342
plus personal contributions for social insurance	+ 77
less imputed interest	− 97
equals Nebraska personal income used in this study.	$3,322

The procedure of the national analysis was followed in having Households pay actual and imputed rents to Real Estate and Rentals. These rental payments cover property taxes, maintenance and repair of housing, and net rents. For the sake of simplicity Household payments to public educational institutions and hospitals were included in payments to State and Local Governments which in turn paid these amounts to Services.

Final Demand

This part of the transactions table reflects final demands for the products of the endogenous sectors. These demands are largely independent of the level of output in the endogenous sectors. Included in the Final Demand part of the Nebraska model are all levels of government, gross private capital formation, net changes in inventories, and exports.

State and Local Governments. The total of purchases by State and Local Governments for 1963 was obtained by averaging the general expenditures of state and local government units for the fiscal years 1962–63 and 1963–64, as reported by the Bureau of the Census. These totals were adjusted downward slightly to remove the operation of sanitation systems from the government sector. Sanitation systems were included in the Utilities sector as are other publicly owned utilities. The activities of the various trust funds of the state and local government units were not included because of data and time limitations. Expenditures for the operation of the system of public education and for public hospitals were allocated to the Service Sector.

Federal Government. The Federal Government column shows the purchases by the Federal Government of goods and services from Nebraska industries. These payments include wages and salaries and transfer payments paid to residents of the state. Federal Government payments to farmers were also included in payments to Households.

Gross Private Capital Formation. Gross Private Capital Formation refers to the expenditures for depreciable structures and equipment by the Nebraska sectors. Such expenditures are not included in the column data for these sectors but are grouped together in Final Demand because they are not closely related to small changes in the current level of output. The column total is a rough approximation subject to later revision.

Net Change in Inventories. The data for Net Change in Inventories were obtained from the studies of endogenous sectors. When the net change in inventories for a particular row sector is subtracted from that sector's total output an estimate of sales by the sector is obtained.

Exports. The last column in the Final Demand part of the table shows the output of the sector which was sold to out-of-state buyers, excluding the Federal Government.

Other Payments

This part of the table represents payments for goods and services purchased from those sectors considered external to the model. In this sense, they are considered part of the exogenous transactions as shown in Table 3.1.

State and Local Governments. This sector was defined to include the receipts for regular government functions. It has been pointed out, however, that receipts for functions which involve public ownership of facilities but which have been considered parts of other sectors, i.e., utilities, have been excluded. Receipts which are used in the operation of educational and medical facilities were included in the total. Transfer payments from the Federal Government were also included, but intragovernmental transfers between state and local governments were excluded.

Federal Government. The row for this sector shows the taxes and other payments collected directly by the Federal Government from Nebraska sectors. In this sense, the actual Federal tax burden of Nebraska is not shown. Households, for instance, bear much of the final burden of excise taxes on certain manufactured goods, but this is not reflected in the table. The excess of Federal Government payments to the state over tax receipts should not be considered the net relation of the Nebraska economy with the Federal Government. The zero payments by agriculture to the Federal Government reflect farm income being treated as flowing to Households who in turn pay federal taxes.

Depreciation. This row is composed of capital consumption allowances on plant and equipment which were charged to current expense by each of the endogenous sectors except Households. Depreciation charges were not computed for Households and the Final Demand Sectors since they are not directly associated with the current level of production of goods and services through the use of capital equipment.

Imports and Other Expenses. Imports reflect the purchases of goods and services from sources located in other states as well as the rest of the world. Other expenses include some items which may have been produced in Nebraska but which were excluded from the state sectors due to the inavailability of data. These include such things as expenditures for certain agricultural services, private refuse systems, and others that are mentioned in the descriptions of the various sectors. This row also includes the retained earnings of corporations and the personal savings of individuals.

ALLOCATIONS

The Nebraska Inter-Sectoral Transactions Table was constructed for 1963 since this is the most recent census year. All transactions and output totals, except the agricultural sectors reflect the state's performance for 1963.

Various combinations of data sources were used in estimating sales and purchase patterns of the endogenous and exogenous sectors. Such sources included published statistics on the Nebraska economy, primary data from survey information, and published statistics on the national economy adjusted to represent state estimates. Data sources for allocations are given in Table B.3.

Agriculture

A three-year average, 1962–1964, was used to compute the output totals for agriculture. The sales and purchase patterns were then adjusted to reflect the three-year average value of output.[2] This procedure was followed for two reasons: (1) When using a calendar year to reflect intra- and intersectoral transactions for agriculture, a production-consumption lag results. For example, a large percent of the value of feed grains produced and held for farm disposition in one calendar year is consumed in the following calendar year. In the transactions table, this production-consumption lag could be handled through inventory adjustments. In other words, feed grains held for farm disposition would be shown as an inventory accumulation, and Livestock and Livestock Products would buy from inventory of the preceeding year. However, since the concern here was to construct a transactions table that would reflect total requirements for a production period, a three-year average for input requirements, sales, and total value of output was used. By using an average, it was assumed that production and consumption occurred in the same calendar year, and that net inventory changes were negligible. (2) Due to the instability in market prices and in growing conditions at the farm level, a three-year average was believed more appropriate as a reflection of the input-output structure for agriculture.

Estimates of the various operating expenses and also the sales patterns for the agricultural sectors were made by diverse methods. Valuable information was gathered from various published sources (see Table B.3). However, with respect to the pur-

[2] Personal income from agriculture did not require an adjustment since the three-year average compared closely with the 1963 estimate of personal income.

TABLE 3.2

Number of Employees of the Sample and Parent Population

Sector Classification	Total Employees	Employees in Sample	Percent of Coverage
Meat Products	12,613	3,701	29
Dairy Products	2,737	1,018	37
Grain Products	3,580	1,388	39
All Other Food and Kindred Products	7,768	3,210	42
Farm Machinery and Equipment	1,582	721	46
Other Machinery and Equipment	7,120	5,861	82
Metals	5,685	2,369	42
Agricultural Chemicals	534	473	89
Other Chemicals	1,551	924	59
Other Manufacturing	21,712	6,148	28

Source: The data on total employment were obtained from U. S. Bureau of the Census, *Census Of Manufactures, 1963*.

chases of materials and supplies by agriculture, these sources did not distinguish between the goods produced in Nebraska and imports. The information obtained from the survey of manufacturing establishments proved to be quite helpful in identifying purchases by agriculture from Nebraska establishments, and also sales by agriculture to Nebraska establishments.

Manufacturing

Little or no published information is available on the sales and purchase patterns of the manufacturing establishments located in the state. The primary source of information used in deriving estimates of sales and expenditures of the manufacturing sectors was personal interviews with a sample of manufacturing establishments. The sampled establishments, for the most part, were limited to those with twenty-five or more employees. For a few sectors, firms with less than twenty-five employees were included in the sample. This was especially true when it was apparent that a large number of firms with less than twenty-five employees comprised a major portion of the sector. If there was reason to believe that those firms with less than twenty-five employees were characterized by a different sales or expenditure pattern than those with twenty-five or more employees, a representative number were also included in the sample.

Although the number of firms which were to be included in the sample was determined at an early stage, the actual size of the sample was dependent on firm response. Table 3.2 shows the number of employees included in the final sample along with the total number of employees in each manufacturing sector. The percent of coverage for each sector is also shown.

The questionnaire used in interviewing the manufacturing establishments included both purchase information and sales information. Even though an inter-sectoral transactions table can be conceptually constructed using purchase information only or sales information only, this duplication in the questionnaire was intentional for two reasons: (1) For those cell entries involving inter-sector transactions of the manufacturing sectors, this provided two independent estimates for the same cell entry. The two independent estimates could then be checked against each other to isolate discrepancies. (2) Requesting information on sales and expenditures provided partial information for the sales and purchase patterns for sectors that were not interviewed. As would be expected some firms were able to provide much more complete information for one part of the questionnaire than for the other.

Other Sectors

The sales and expenditure patterns for the remaining sectors were derived from a variety of sources. Published statistics, separate studies of several sectors, survey information obtained from the manufacturing establishments, and national averages and ratios were combined in what was felt to be the most reliable estimate of transactions (see Table B.3 for data sources). Except for certain cases where published data were available, the cell entries in the Final Demand and Other Payments parts of the table were obtained from the individual studies of the endogenous sectors.

CHAPTER IV

INTERPRETING THE INPUT-OUTPUT TABLES

Regional input-output analysis includes at least three general tables which depict the interindustry relations of the regional economy under study. These are the transactions table, the direct requirements table, and the total requirements table. In this chapter these tables will be explained and interpreted so that their use in measuring economic impact may be understood.

A verbal explanation will be given first, both in terms of a simple hypothetical model and also with reference to the Nebraska tables. Secondly, for the benefit of those readers who are interested in the mathematical logic behind the tables, the meaning and derivation of the tables will be explained algebraically. This part of the explanation may be omitted by those not interested in this aspect. Thirdly, some preliminary discussion will be given to the use of the tables in impact measurement.

A VERBAL EXPLANATION

A Simple Hypothetical Economy

Consider first a simple hypothetical economy in which all productive activity is carried on within three industries or sectors. These are called the endogenous sectors. Suppose that these are agriculture, trade, and manufacturing. Suppose further that Table 4.1 describes the transactions which occurred in this hypothetical economy during a particular year.

To interpret this *transactions table,* it should be kept in mind that the row sectors are considered to be selling to the column sectors, or conversely, that the column sectors are considered to be buying from the row sectors. Thus a particular row shows the sales of that row sector to the column sectors, with total sales indicated at the right end of the row.[1] According to the manufacturing row of Table 4.1, manufacturing had total sales of 20 million dollars. The sales within the local economy involved 4 million dollars to agriculture, 3 million to trade, and 2 million to manufacturing; that is, the firms within manufacturing sold 2 million dollars of goods to each other. In addition, manufacturing had sales of 11 million dollars to final demand, which usually includes such sectors as consumption, investment, and exports from the region.

TABLE 4.1

A Transactions Table for a Hypothetical Economy

(Each cell shows the sale of the row sector to the column sector. The units are in millions of dollars.)

Selling Sectors	Purchasing Sectors				
	Agri.	Trade	Mfg.	Final Demand	Total
Agriculture	8	6	6	20	40
Trade	4	2	1	23	30
Manufacturing	4	3	2	11	20
Payments Sector	24	19	11	0	54
Total	40	30	20	54	144

The manufacturing column shows how this industry used its revenues of 20 million dollars to purchase from and make payments to the several sectors. Payments to agriculture for goods were 6 million dollars, to trade 1 million, and to manufacturing 2 million; and 11 million dollars worth of other payments were made outside of local business. While these other payments are aggregated here, they are often broken down into such exogenous sectors as imports, depreciation allowances, and household income. In a similar way the other two endogenous sectors, agriculture and trade, may be examined.

The hard-ruled rectangle of Table 4.1 contains the internal or endogenous transactions of the hypothetical regional economy. The other transactions involving the final demand and the other payments sectors are exogenous transactions. In general, the transactions table is easy to read and understand if two important rules are followed:

1) A row shows the sales of the row sectors to the column sectors.
2) A column shows the purchases of the column sector from the row sectors.

The next type of input-output table to be considered is the *direct requirements table* which is illustrated in Table 4.2 for the same hypothetical economy. This table is obtained from the transactions table by a series of division computations. Each column of the direct requirements table is obtained from the corresponding column in the transactions table by expressing each column entry of the transactions table as a decimal fraction of the column total. Of course, the result is a column of decimal fractions whose sum is one.

[1] It is assumed here that industry sales equal industry output and that there is no change in inventories.

TABLE 4.2

A Direct Requirements Table for a Hypothetical Economy

(Each cell shows the *direct* requirements of the column sector upon the row sector per dollar of output of the column sector.)

Selling Sectors	Purchasing Sectors		
	Agri.	Trade	Mfg.
Agriculture	.20	.20	.30
Trade	.10	.07	.05
Manufacturing	.10	.10	.10
Payments Sector	.60	.63	.55
Total	1.00	1.00	1.00

The manufacturing column in Table 4.2 indicates that, in this hypothetical economy, for each dollar of manufacturing output, manufacturing bought about 30¢ worth of goods from agriculture, 5¢ from trade, and 10¢ from manufacturing, and made other payments of 55¢. The first three are requirements from endogenous sectors and the last is an exogenous requirement, that is, it involves a payment in which the money spent leaves the endogenous part of the model. The other columns may be interpreted similarly.

The 3 by 3 matrix in the dark-ruled rectangle of Table 4.2 shows the direct requirements of the local industries on each other per dollar of output. Often only this part of the table is presented as the direct requirements table because it focuses attention upon the direct requirements of the endogenous sectors upon each other.

These direct requirements are frequently referred to as input coefficients or as technical coefficients. Actually, the term "technical coefficient" applies best to a nearly self-sufficient national economy which imports only a very small fraction of its total requirements for production. In this case, it is chiefly the level of technology which determines the pattern of input coefficients. However, in the case of a regional economy which imports many of its direct requirements, the input coefficients depend upon the technology of production and the trade flows—and the latter may dominate for some coefficients. For this reason, the term "input coefficient" is more appropriate for a regional economy than the term "technical coefficient."

It would be well to note at this point that an input coefficient as described above is an average requirement per dollar of output. If this average is used in measuring the input requirements for a given output, it needs to be recognized that one is assuming that the various inputs, except for capital goods, maintain a constant proportion to the outputs of an industry. If the industry is narrowly defined, if the technology is constant, if the trade flows are stable, and if relative prices are stable, the assumption of a direct proportion between an input and the output of the industry may not be unrealistic. The preceding statement, however, also points up situations in which the use of these coefficients would hardly be appropriate. For example, the coefficients developed out of tables computed for one year may apply quite well for adjacent years, but lose their applicability for years farther removed.

The direct requirements table shows what one might call the first round effects on the endogenous sectors of an increase in output and sales to final demand of one of the endogenous sectors. In the hypothetical economy the direct impacts which result when manufacturing increases its output have already been noted. These direct impacts stimulate further activity in the endogenous sectors. For example, agriculture, which was required to supply 30¢ worth of goods to manufacturing so the latter could increase its output by one dollar, now needs to purchase inputs so that it can produce the 30¢ worth of product. By utilizing agriculture's direct requirements column, one could compute the extra inputs needed by agriculture from its suppliers. These suppliers in turn will need to purchase inputs to meet the demands upon them. And so the chain of reactions would continue. Of course each successive round of transactions would be smaller than the preceding because of the leakages of purchasing power from the local economy. After a few rounds, the remaining impacts would very likely be of negligible size.

To take account of all the indirect impacts, one would apply a similar analysis to each of manufacturing's endogenous suppliers. However, attempting to measure total impact this way would be an exceedingly laborious procedure. Fortunately, the application of some matrix algebra and the use of an electronic computer make the computation of a *total requirements table* quite feasible. This type of table for the hypothetical economy is illustrated in Table 4.3.

Each column of the total requirements table gives the direct and indirect production requirements which the endogenous sectors must meet to enable the column sector to increase sales to final demand by one dollar. Thus, for manufacturing to increase its sales to final demand by one dollar, agriculture must increase its output by about 47¢ and trade by 11¢. Manufacturing itself must produce $1.17 worth of product which includes the $1 worth of product going to final demand. The re-

TABLE 4.3

A Total Requirements Table for a Hypothetical Economy

(Each cell shows the *direct* and *indirect* requirements upon the row sector per dollar of sales to final demand by the column sector. The sum of the column entries gives an industry multiplier for the column sector.)

Selling Sectors	Purchasing Sectors		
	Agri.	Trade	Mfg.
Agriculture	1.3419	.3387	.4661
Trade	.1532	1.1129	.1129
Manufacturing	.1661	.1613	1.1677
Multiplier	1.6612	1.6129	1.7467

maining 17¢ includes manufacturing's direct requirement upon itself of 10¢ and an extra 7¢ of product which must be produced to enable agriculture and trade to supply inputs to manufacturing. By using the direct requirements table in conjunction with the total requirements table, the indirect requirements may be computed.

The sum of the column entries in the total requirements table is given at the bottom of the column and is known as the final demand multiplier for the column industry. Manufacturing's multiplier for the hypothetical economy is $1.75, which means that for manufacturing to increase its sales to final demand by one dollar, the endogenous sectors must increase outputs together by $1.75. It can also be said that the sale of $1.00 of output to final demand generates internal transactions in the regional economy totaling $1.75. It should be realized that this $1.75 of increased outputs is not a net product concept but includes some double counting, since some of this production consisted of inputs supplied to manufacturing which in this case produced the goods for final demand.

The three tables just discussed in the case of the hypothetical economy are the basic tables developed in input-output analysis. With a set of such tables the functioning of an economy and its interrelationships may be examined in considerable detail. With this general background in mind, some observations about the Nebraska tables can now be made.

The Nebraska Tables

The three basic input-output tables for the Nebraska economy are presented as Tables C.1, C.2, and C.3 of Appendix C. As noted in the preceding chapter, the Nebraska model contains 23 endogenous sectors. Final demand has been separated into 5 sectors and other payments into 4 sectors.

Table C.1 is the Transactions Table. In this study considerable attention will be focused upon Sectors 2 and 3, Irrigated Crops and Dryland Crops. By scanning rows 2 and 3 of the Transactions Table, one can see that the main endogenous customers of Sectors 2 and 3 are the Livestock and Livestock Products Sector and the Grain Products Sector. Irrigated Crops also made substantial sales to Other Foods and Kindred Products, which consisted chiefly of sales to sugar beet processors. The final demand sector which serves as a customer of Sectors 1 and 2 is Exports.

The columns for Irrigated Crops and Dryland Crops show the purchases of inputs by these two sectors. One can see that outlays to the exogenous sectors are very substantial, with the outlays to Imports and Others being the largest outlays for both Sectors 2 and 3. The Depreciation outlay, a substantial one, is the item which permits the systematic charging of capital expenditures to current expenses over a period of years. It should be recalled that the purchases of capital equipment are not included as current expenses in income statements and are thus not included as purchases in the column entries for a sector.[2] The outlays included in the columns of the endogenous sectors are outlays chargeable to current expenses.

Among the outlays to the endogenous sectors, the one to Households is the largest for both Sectors 1 and 2, as might be expected. The outlay to Real Estate and Rentals is next largest. It should be recalled from the preceding chapter that this includes the imputed gross rent of owner-occupied farm dwellings.[3] The next largest outlays include those to Trade, Finance, Services, and Livestock.

The Transactions Table provides estimates of the flows of outputs and inputs involving the endogenous sectors during 1963. It also shows the division of the output of a sector between internal customers and exogenous customers and the division of the outlays between internal suppliers and exogenous sectors. While one is interpreting particular transactions, it may occasionally be helpful to refer to the industry descriptions in Table B.1. If more detail is desired, Chapter 3 should be consulted.

Table C.2 is the Direct Requirements Table for the Nebraska economy for 1963. Each entry is the decimal fraction which the corresponding item in the Transactions Table is of the column total. Thus, the second column gives the inputs required by Irrigated Crops per dollar of output. For each

[2] The fixed capital expenditures of all sectors are lumped together and included as part of final demand in the sector labeled Gross Private Capital.

[3] The Real Estate Sector in turn pays the net rent to Households.

dollar of output, Irrigated Crops requires on the average 19¢ worth of inputs from Households, about 16¢ from Real Estate, and somewhat over 4¢ from Trade. The other entries may be interpreted in similar fashion. Only the inputs required of the endogenous sectors call forth further activity within the economy of Nebraska. The way in which Households, Real Estate, Trade and the other suppliers of Irrigated Crops spend their receipts from that sector influences the further proliferation of impact upon the economy.

The direct requirements shown in Table C.2 plus the indirect requirements which result by way of a chain reaction of further spending add up to the total requirements which are shown in Table C.3. In column 2 of this table are given the total requirements which are placed upon the endogenous sectors by a dollar's worth of output sold by Irrigated Crops to Final Demand. Of course, the largest total requirement is upon Irrigated Crops itself which needs to produce the dollar's worth of product going to Final Demand plus an extra two cents of product. Most of this latter (1.474¢, as indicated in the Direct Requirements Table) is seed which Sector 2 must produce so that it can produce for Final Demand, but a small part of the two cents goes to other endogenous sectors so that they can supply Irrigated Crops with its needs.

The next largest total requirement in column 2 is that supplied by Households. For each dollar of output to Final Demand, Households must supply about 48¢ worth of inputs (mostly labor). Only about 19¢ worth is supplied directly to Irrigated Crops, according to the Direct Requirements Table. The remaining 29¢ worth is supplied indirectly, mainly to the other endogenous sectors so that they can sell the necessary inputs to Irrigated Crops. The 48¢ can also be looked upon as the addition to household or personal income generated by the sale of Final Demand of one dollar of product of Irrigated Crops.

The other entries in the second column of the Total Requirements Table are subject to similar interpretations. All these entries may be summed to give a total of 2.19402 which is the final demand multiplier for Irrigated Crops in Nebraska. This multiplier indicates that for each dollar's worth of sales to Final Demand by Irrigated Crops, the outputs of all the endogenous sectors together must increase by about $2.19. The cell entries in the column indicate what part of this total must be produced by each endogenous sector.

The other columns are subject to similar analysis. For example, the total requirements of Dryland Crops may be readily compared with those of Irrigated Crops. The final demand multiplier of the former is 1.94757, somewhat below that of the latter. By examining and comparing cell entries for the two sectors, it appears that the higher multiplier for Irrigated Crops is due mainly to larger total requirements from Households and Real Estate. There are other cell-to-cell differences, but these two are the most dominant.

It may be of interest to note that a number of other sectors have larger multipliers than the two noted above. For example, the Livestock, Meat Products, Dairy Products, and Grain Products Sectors have considerably larger multipliers. Of course, this can be attributed in part to the rather substantial total requirements which these sectors impose on Irrigated and Dryland Crops. In general, the larger the direct requirements a sector imposes upon the endogenous economy, the larger its multiplier tends to be. Conversely, the larger the direct requirements imposed upon the exogenous sectors, the smaller the multiplier tends to be.

AN ALGEBRAIC EXPLANATION

The input-output tables that have been developed in this study can also be explained algebraically. The Transactions Table shows the sales and purchase relationships between the endogenous sectors. It also shows the interactions of these processing sectors with the components of the exogenous part of the model.

The elements in each row of the Transactions Table show the disposition of the output of that sector to the other endogenous sectors and to the final demand sectors. The outputs of the sectors can be designated as $X_1, X_2 \ldots X_n$ where n is the total number of endogenous sectors. X_1 is the output of Sector 1, X_2 is the output of Sector 2, and so on. The flow of goods between two sectors can be designated as x_{ij} which denotes the amount of product moving from producing sector i to purchasing sector j.

Part of the output of the producing sectors is sold to Final Demand which comprises the government sectors, changes in inventories, gross private capital formation, and exports from the state. Let this part of the output of sector i be represented by Y_i. Then with X_i representing total output of sector i and x_{ij} measuring the flow of output from sector i to sector j, it follows that:

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i \qquad (i = 1, 2 \ldots n)$$

The total output of any sector is equal to the sum of the flows from that sector to the endogenous sectors plus the flow to final demand.

The inputs purchased by each endogenous sector are shown in the column for that sector. The total of the inputs (or the total outlays for inputs) can be represented as X_j. Since, for a processing sector, the total output is equal to the total input, X_j is equal to X_i where i equals j.

Some of these inputs are purchased from the endogenous sectors of the economy. The elements in each column can again be represented as x_{ij} since a sale by producing sector i to purchasing sector j is the same as a purchase by sector j from sector i. The remainder of the column entries are outlays to exogenous sectors such as governments, depreciation, imports, and other expenses. The total of these exogenous payments may be designated as V_j. It now follows that:

$$X_j = \sum_{i=1}^{n} x_{ij} + V_j \qquad (j = 1, 2 \ldots n)$$

The total of the inputs of each sector is equal to the sum of the outlays to the endogenous sectors plus the outlays to the exogenous sectors.

The coefficients in a column of the direct requirements table indicate the amount of product from each of the row sectors required by the column sector to produce one dollar's worth of output. Any one of these coefficients, designated a_{ij}, shows the per dollar requirements of sector j from sector i. The a_{ij}'s are derived by dividing each column entry of the transactions table x_{ij} by the column total. Thus

$$a_{ij} = \frac{x_{ij}}{X_j}$$

From the definition of a_{ij}, it is apparent that x_{ij} is equal to $a_{ij}X_j$. The total amount of product flowing from producing sector i to purchasing sector j is equal to the amount purchased from sector i per dollar of output by sector j multiplied by the total input (or total output) of sector j. The disposition of total output of sector i can now be formulated as:

$$X_i = \sum_{j=1}^{n} a_{ij}X_i + Y_i \qquad (i = 1, 2 \ldots n)$$

There exists a system of equations of this type, one equation for each endogenous sector. The output totals of this system form a column vector, the input coefficients of the direct requirements table form a matrix, and the final demand sectors could be aggregated to form a column vector. In matrix algebra, this system of equations can be formulated as:

$$\begin{vmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ \cdot \\ X_n \end{vmatrix} = \begin{vmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{vmatrix} \cdot \begin{vmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ \cdot \\ X_n \end{vmatrix} + \begin{vmatrix} Y_1 \\ Y_2 \\ \cdot \\ \cdot \\ \cdot \\ Y_n \end{vmatrix}$$

If X represents the column vector of output totals, A represents the matrix of input coefficients, and Y the column vector of Final Demand, then

$$X = AX + Y$$

The Total Requirements Table shows the accumulated impact upon the output of each sector as one sector sells an additional amount to Final Demand. Employing the use of the identity matrix and matrix algebra, the above equation can be converted to:

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

where $(I - A)^{-1}$ is the matrix of total requirements. It is calculated by inverting the $(I - A)$ matrix which is the identity matrix (in which all elements in the diagonal are 1 and all other elements are zero) minus the matrix of input coefficients. Output of each sector is then expressed as a function of the exogenous Final Demand.

An element of the Total Requirements Table can be designated as c_{ij} which shows the total of direct and indirect increases in the output of sector i as sector j sells an additional dollar's worth of output to Final Demand. The last row in the Total Requirements Table provides a final demand multiplier for each column sector. It is the sum of the entries in each column:

$$M_j = \sum_{i=1}^{n} c_{ij} \qquad (j = 1, 2 \ldots n)$$

Each M_j represents the total activity generated within the economy as sector j sells one dollar's worth of its output to Final Demand.

USING THE MULTIPLIERS IN IMPACT ANALYSIS

If it is known that a particular sector of the Nebraska economy, say Irrigated Crops (Sector 2), has increased its exports from the state (a part of Final Demand) by 10 million dollars in a recent year, how can the impact of these increased exports on the Nebraska economy be estimated? Assuming that the 1963 input coefficients can be considered realistic for the year in question, the Total Requirements Table (Table C.3) can be used to answer this question.

The final demand multiplier for Sector 2 indicated in the Total Requirements Table is 2.19402. Multiplying this by the 10 million dollar increase in exports gives $21,940,000 (assuming accuracy to the nearest thousand). This amount is the total of the output increases of the endogenous sectors which were necessary to enable Irrigated Crops to sell the 10 million dollars of product to Final Demand. The 10 million dollars of product is of course included in the larger total.

The multiplier, in this case 2.19402, is the sum of the entries in column 2 of the Total Requirements Table. Each of these entries gives the impact on a particular endogenous sector of a dollar increase in output to Final Demand by the column sector. Thus the entry for the Trade Sector is .12487 (or about 12.5¢). Multiplying this by 10 million dollars gives $1,249,000 (to the nearest 1,000). The Trade Sector's margin increased by $1,249,000 as a result of the 10 million dollar increase in exports by Irrigated Crops.[4]

By the same logic, the output of Agricultural Chemicals increased by $86,000, the output of Finance by $389,000, and the output of Utilities by $447,000, to give a few examples. Using the Household entry, an increase of $4,790,000 in personal income is noted.

These various impacts resulted from the increases in current activity necessary to enable Irrigated Crops to increase its exports by 10 million dollars. In computing these extra outputs by the endogenous sectors, it is assumed that each sector has the existing capacity to support such increases. The tables do not directly indicate any induced investment activity. If, however, the necessary investment data were available, the tables could be used to estimate an investment impact. Such data would need to indicate the quantity of investment activity attributable to irrigation and whether the investment goods were imported or produced in Nebraska. In the latter case, the data would need to indicate the sectors involved. Sector multipliers could then be used to estimate impact.

In the preceding discussion, an increase in output going to exports was assumed to develop. In this case the use of the final demand multiplier is appropriate, because exports are part of Final Demand and the multiplier takes into account that the Irrigated Crops Sector will actually have to produce somewhat more than 10 million dollars of output in order to sell that amount to Final Demand. It will have to use up some of its own production as seed in order to produce for Final Demand. In fact, the Total Requirements Table indicates that Irrigated Crops will have to produce some $10,203,000 of product to be able to export $10,000,000 worth of product.

If it is assumed that the actual output of Irrigated Crops increases by $10,000,000, the amount available for exports would be something less than $10,000,000, for some of the output would be used up in the production process. In this case, an output multiplier would be appropriate, rather than a final demand multiplier, and the former would be smaller than the latter.

An output multiplier[5] may be obtained by adjusting the final demand multiplier. The Total Requirements Table indicates that, for Irrigated Crops to sell one dollar of output to Final Demand, the endogenous sectors need to increase their outputs by amounts which total $2.19402 and that the Irrigated Crops Sector itself needs to produce $1.02034. Thus the total requirements upon all sectors of $2.19402 may be related to the total requirements upon Irrigated Crops of $1.02034. Dividing the former number by the latter gives 2.1502, which is the output multiplier for Irrigated Crops. This number is the total of the outputs required from the endogenous sectors *per dollar of output* by Irrigated Crops.[6]

The output multiplier for the Dryland Crops Sector is also required for the impact analysis which is developed in the next chapter. When the final demand multiplier for this sector, 1.94757, is divided by the total requirements for this sector upon itself when selling to final demand, 1.01899, the resulting output multiplier is 1.91127.

It is one of the chief advantages of input-output analysis that these types of sector multipliers can be developed. These characteristics, in conjunction with other relationships developed from the input-output tables for the Nebraska economy, are the tools by which estimates of the impact of irrigated agriculture upon the Nebraska economy are developed in the following chapter.

[4] It should be recalled that the output of the Trade Sector includes only the margin retained by the Wholesaler or Retailer. See Chapter III for further explanation of the treatment of this Sector.

[5] This concept was explained in U.S. Bureau of Labor Statistics, *The 1947 Interindustry Relations Study*, BLS Report No. 33, p. 15.

[6] If desired, all the entries in the second column of the total requirements table may be similarly adjusted to give the total requirements on each endogenous sector per dollar of output by Irrigated Crops.

CHAPTER V

THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE

INTRODUCTION

Although the Irrigated Crops Sector is becoming a major producer of agricultural output in Nebraska, there is remarkably little empirical information as to the impact of this sector on the state's economy. Only in recent years have those states concerned with regional development and the role of irrigation in regional development undertaken to measure the impact of irrigation. In some studies empirical models used have been somewhat limited in that they have not attempted to separate the various types of impacts. The model used in this study is a more detailed model. Hopefully, a better measurement of the economic impact of irrigation can be developed.

An attempt to understand and measure the impact over time of any sector of a regional economy upon that economy requires some notion of the strategic variables initiating regional growth. One theory of regional growth rests on the export base concept where the growth of the region is primarily a function of those sectors serving a market outside of the region. For an economy such as Nebraska, agriculture appears to be a major exporting sector, as is apparent from the Transactions Table for Nebraska (Table C.1). About 31 per cent of agriculture's output was exported. It should be pointed out that this percentage reflects an average for the three-year period 1962-64. When those agricultural products being processed in the state but sold outside of the state are added to this figure, over 60 per cent of agriculture's output is sold outside of the state.

As the output of the Irrigated Crops Sector expands, primarily serving markets outside of the state, growth can be expected to occur in closely linked sectors within the economy because of the increased pressure to supply a growing demand for goods and services used in irrigation. Furthermore, as the magnitude of some of these demands reaches certain threshold values, new establishments are attracted to the state to further supply the increasing demands. At the same time that crop production is increasing, growth is initiated in the closely linked crop processing sectors. This development stimulates the location of new processing industries in the state as well as the expansion of existing processing plants. To complete the picture, growth will eventually take place in the trade, transportation, services, and other secondary and tertiary sectors which may or may not be closely linked with agriculture. It should be kept in mind, however, that agriculture, and in particular Irrigated Crops, may not be the only basic sector in Nebraska which is initiating economic growth for the state.

THE TYPES OF IMPACT

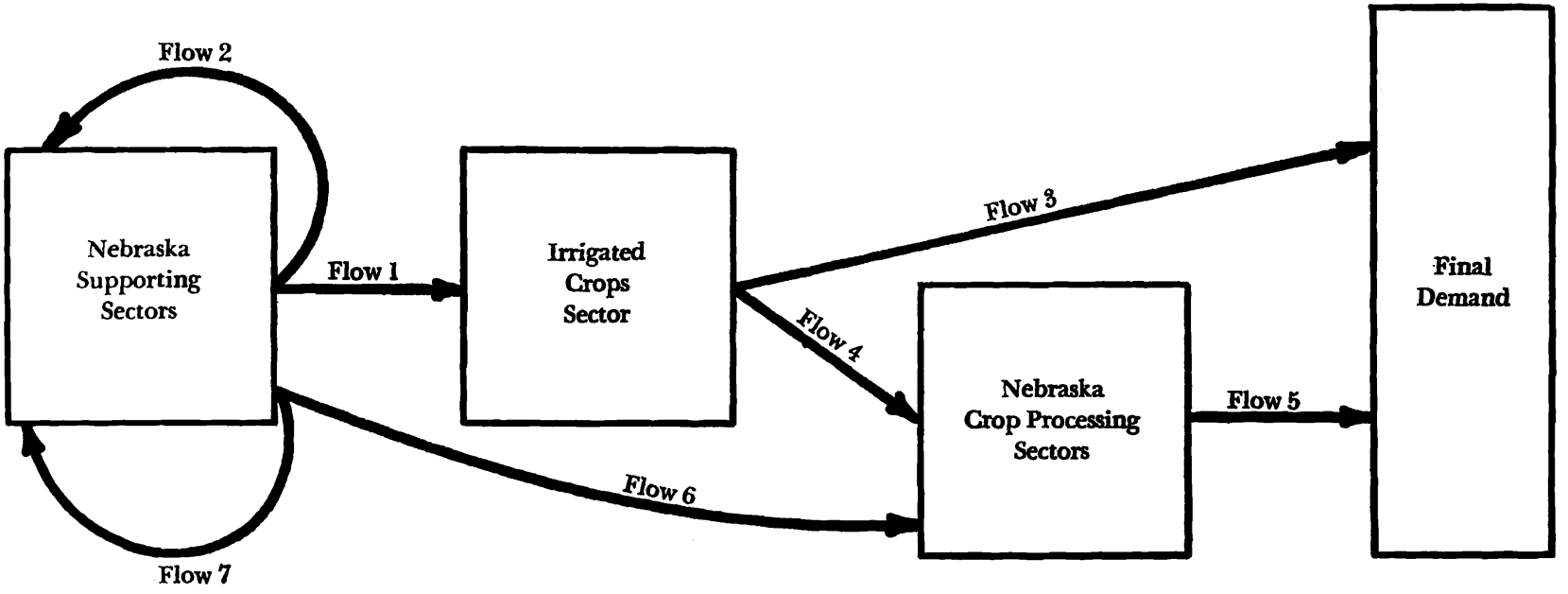
The incremental increase in crop production attributed to irrigation during a production year sets in motion various waves of spending and respending within the Nebraska economy. The result is usually a higher level of gross product and presumably increased personal income. In short, irrigated agriculture has a certain economic impact on the state's economy which can be measured in terms of an increase in gross output, an increase in personal income, or possibly some other unit of measurement. In the main gross output (or gross income) has been used in this study to measure the economic impact due to irrigation.

The economic impact of the Irrigated Crops Sector on the state's economy can conceptually be separated into (a) the short-run impact due to the additional crop production attributed to irrigation during any production period, and (b) the long-run impact resulting from investment activity in all sectors, including Irrigated Crops, which may be attributed to the expansion of Irrigated Crops' output. The two types of impact will be referred to as current impact and investment impact, respectively.

Current Impact. To measure current economic impact for a production period, the total structure of the economy is assumed to remain unchanged. This assumption implies stability with respect to technology, trade patterns, and relative prices. It is also assumed that the necessary capacity exists in all sectors located within the economy to accommodate any increased activity stimulated by irrigation.

CHART 5.1

Intersectoral Flow Chart



Current Direct Impact: Flows 3 and 4.

Current Induced-by Effects: Flows 1 and 2.

Current Stemming-from Effects: Flows 5, 6, and 7.

Current impact can be delineated into current direct and current indirect impacts. *Current direct impact* refers to the net increase in agriculture's crop output which accompanies irrigation. *Net increase* implies the increase over and above that which could have been produced by dryland farming methods on the irrigated land. It should be noted again that irrigation is used in this study to refer to the total package of inputs used in the Irrigated Crops Sector. For example, some of the increase in output may be due to an increase in the application of fertilizer which is made possible by irrigation.

The current indirect impact includes two types of effects. The growth of irrigation increases the demand for crop inputs since a net increase in crop output accompanies irrigation. This sets in motion an increase in the spending and respending activity of the internal economy which leads to an increase in the level of transactions of some or all the endogenous sectors. This impact has been referred to in this study as the *current induced-by effects* of irrigation. In addition to the current induced-by effects of irrigation, it can be argued that the net increase in crop output can lead to an increase in the level of crop processing in the state. The spending and respending activity associated with the increase in the level of crop processing has been termed the *current stemming-from effects.* Both of these effects are current effects in the sense that they do not include the effects of investment activity, but assume that the necessary capacity for carrying on the economic activity exists.

The foregoing definitions of current economic impact can best be summarized and clarified by Chart 5.1. The flow chart traces the effects of a net increase in crop output due to irrigation. When a net increase in crop output occurs (the direct effect), the level of activity within the supporting sectors increases to meet the increased demand for crop inputs. In the chart, flow 1 shows the flow of direct inputs from the Nebraska supporting sectors to the Irrigated Crops Sector. In addition, the chart shows an arrow looping back upon the supporting sectors—flow 2. Flow 2 indicates the feedback effects which occur as the level of sales to the Irrigated Crops Sector is increased. To be more specific, the feedback effects refer to the additional activity generated in the internal economy to enable those sectors to supply the necessary inputs (flow 1) to Irrigated Crops so that it can produce the net increase in crop output. The feedback effects (flow 2) and the increase in the level of crop inputs (flow 1) have been defined as the *current induced-by effects* of irrigation.

Flows 3 and 4 show the net increase in crop output—the current direct impact. Flow 3 indicates that a portion of this increase will flow directly to Final Demand. Flow 4, on the other hand, shows that some of the net increase in crop output flows to Final Demand via the Nebraska crop processing sectors. In order for the crop processing sectors to process the additional flow of crop inputs, an increase in the purchase of direct inputs from the Nebraska supporting sectors is called for. This is shown in the chart as flow 6. As the additional support requirements to the crop processing sectors are met, certain feedback effects occur. These feedback effects refer to the additional activity generated in the internal economy to enable those sectors to supply the necessary inputs to the crop processing sectors (flow 6) so that they can process a fraction of the net increase in crop output (flow 4). The feedback effects, as defined here, are shown as flow 7. Flows 6 and 7 as well as the output of the crop processing sectors going to Final Demand as flow 5 have been defined as the *current stemming-from effects* of irrigation. However, the direct crop input to the crop processing sectors and the activity associated with this input are not a part of the current stemming-from effects since this activity has already been defined as part of the current direct and current induced-by effects of irrigation.

Investment Impact. The impact of investments refers to the effects on the internal economy of investments which are directly and indirectly associated with the growth of the Irrigated Crops Sector. *Direct investments* refer to the investments needed to provide the water supply and distribute it to the cropland and to the additional farm machinery needed. Thus, direct investments in irrigation would include the construction of reservoirs, canals, and wells, plus investments in irrigation pumps, sprinkler systems, and so on. In contrast, *indirect investments* associated with irrigation refer to the expansion of existing facilities and/or the location of new facilities to supply the increasing demand for crop inputs and/or to process the increase in crop output. The direct and indirect investments, as any capital investment, will generate additional activity for the Nebraska economy. Merely describing these investment effects can bring to mind numerous problems in measuring such impacts. These problems will be discussed later in this chapter.

The following outline lists the various types of impact that have been noted:

Current Impacts
- Direct
- Indirect
  - Induced-by
  - Stemming-from

Investment Impacts
- Direct
- Indirect

These impacts will now be considered in this order.

CURRENT DIRECT IMPACT

The current direct impact of the Irrigated Crops Sector on the Nebraska economy for a given year is equal to the output of that sector less what would have been produced on the irrigated land under dryland conditions. Estimates of this impact have been computed for the period from 1946 through 1965. The outputs of Irrigated Crops for each of these years and estimates of what would have been produced under dryland conditions—the dryland equivalents—are given in Table 5.1.

The dryland equivalents require some explanation. These hypothetical outputs for each year were simulated for those acres under irrigation. To be more specific, each of the irrigated crops was hypothetically removed from production and a dryland crop was substituted as a replacement. The irrigated crops are corn, oats, barley, grain sorghum, potatoes, sugar beets, soybeans, dry edible beans, and alfalfa. Usually the same crop was assumed to be grown under dryland conditions. For sugar beets, dry edible beans, and potatoes, the replacement was assumed to be dryland corn.

As an illustration, consider the case of irrigated corn in 1964. The annual reports of the Nebraska Department of Agriculture and Inspection give the acreage, yields, and total corn production of irrigated and dryland corn by county.[1] Prices received are also reported by crop reporting districts. With the aid of such data for 1964 it was estimated that, if the irrigated corn in that year had been replaced by dryland corn, the substitution would have been valued at $44.306 million. Added to the dryland corn value of $128.891 million (computed by crop reporting district price), the substitution and the actual dryland corn production for 1964 would have been $80.721 million less than the value of the actual crop output (including dryland and irrigated crop production). This net difference then is attributable to the Irrigated Crops Sector.

[1] *Nebraska Agricultural Statistics, Annual Reports.* The Nebraska Department has the cooperation of the Statistical Reporting Service of the U. S. Department of Agriculture in providing such data.

TABLE 5.1

Net Increases in Agricultural Crop Production due to Irrigation, 1946-65.

Year	Irrigated Output	Dryland Equivalents	Net Increase in Crop Output
	(thousands of dollars)		
1946	$ 59,605	$17,525	$ 42,080
1947	71,681	25,898	45,783
1948	60,285	25,579	34,706
1949	58,458	24,263	34,195
1950	69,080	30,063	39,017
1951	70,337	29,606	40,731
1952	82,305	29,705	52,600
1953	83,504	23,492	60,012
1954	90,079	26,918	63,161
1955	101,694	19,198	82,496
1956	134,343	17,884	116,459
1957	149,172	60,891	88,281
1958	150,966	70,712	80,254
1959	161,772	68,383	93,389
1960	165,882	64,055	101,827
1961	167,912	64,629	103,290
1962	165,524	80,573	84,951
1963	192,918	71,275	121,643
1964	199,718	67,422	132,296
1965	207,994	83,465	124,529

Source: The data were computed from production and price data reported in Nebraska Department of Agriculture and Inspection, *Nebraska Agricultural Statistics, Annual Reports.*

Such computations were made for all the irrigated crops for each year and totals for each year were obtained. The net differences in gross output which resulted from this procedure are shown in Table 5.1. These are the estimates of current direct impact for each year resulting from the continued shift of land from the Dryland Crops Sector to the Irrigated Crops Sector. It is apparent from the table that the current direct impact of irrigation has increased roughly three-fold during the postwar period.

CURRENT INDUCED-BY EFFECTS

The net increase in gross income (output) for crop production which was just explained is a measure of the yearly current direct impact of irrigation. However, in order to produce these increased outputs, the Irrigated Crops Sector needs to purchase various inputs. Moreover, the suppliers of these inputs need to increase their purchases of inputs. Thus, as was explained in the preceding chapter, the current direct impact sets in motion various rounds of current expenditures for inputs of goods and services. Some of these goods and services are produced within Nebraska and some are imported. The current induced-by effects refer to the total transactions generated from the spending and respending of current receipts for those goods and services produced within the Nebraska economy.

As an illustration, each dollar's worth of output

(gross income) from Irrigated Crops requires various expenditures on inputs to produce that dollar of output. As shown in the Direct Requirements Table (Table C.2), every dollar of output for Irrigated Crops requires about 4 cents of services from the Trade Sector (reflecting also the trade margin for imports), about one cent from Agricultural Chemicals, and so on. These supplying sectors must in turn purchase inputs in order to supply the goods and services going to Irrigated Crops. For example, the Trade Sector purchases about 2.6 cents of services from the Utility Sector in order to supply one dollar of service. Thus one dollar of output from Irrigated Crops requires that the Trade Sector purchase (4)x(0.03) cents of services from the Utility Sector in order to supply the four cents of services to Irrigated Crops.

A similar wave of spending occurs from the payments (income) to the Household Sector. Households receive about 19 cents for every dollar of crop production grown under irrigation. The Household Sector in turn spends about (19) x (0.015) cents on Meat Products, and so on.

The reader should note from Table C.2 that the Household consumer spends about 36 cents on imports per dollar of income. This transaction is a leakage from the internal economy. Similar leakages occur in the purchase of goods and services used up in the production processes of all endogenous sectors in the internal economy. For instance, the Irrigated Crops Sector requires about 26 cents from imports for every dollar of output. Since each additional round of current expenditures includes expenditures on imports in addition to the purchase of domestic goods and services, the total amount of transactions generated internally from a dollar of increased crop production will depend on the size of the leakages.

The accumulated effect of these rounds of expenditures can be estimated by means of the Total Requirements Table (Table C.3) and the industry or sector multipliers explained in Chapter IV. To estimate the current induced-by effects resulting from a net increase in crop output, the output multipliers were used. As already noted, an output multiplier for any sector is associated with the structure of the internal economy and the size of external leakages. As internal linkages vary, the size of the output multiplier can also vary. It is conceivable, however, that structural change can occur without any noticable effect on the output multiplier for a particular sector. As long as there is no significant change in the external leakage flow, there should be no significant change in the output multiplier.

The output multipliers for Irrigated and Dryland Crops, which were developed in Chapter IV, should reflect the general economic structure of the state for those years close to 1963. The purchase and sales patterns for each of the agricultural sectors were estimated by using a three-year average for the years 1962-64. The averages should be representative of the general input and sales patterns for agriculture for the early 1960's.

To arrive at an estimate of the output multipliers for Irrigated and Dryland Crops for the early postwar period, an interindustry direct requirements matrix was estimated. Unfortunately, the method used in the construction of the 1963 Nebraska Transactions Table (and the Direct Requirements Table) could not be used in the construction of the same model for the late 1940's. Construction by a second method, not uncommon in the construction of regional input-output models, was attempted.[2] This method involved the use of a combination of sector output totals for the state and national technical coefficients. The results, however, were difficult to interpret and in some cases did not seem reasonable.[3] Thus the output multipliers based on this procedure were not used.

The method finally used to estimate output multipliers applicable to the late 1940's was to first adjust the Direct Requirements Table for 1963 (Table C.2) so as to reflect the economic structure for 1947. This was done first by considering technological changes that have occurred between 1947 and 1963 (particularly in agriculture), and secondly by considering possible changes in trade patterns. In order to adjust the direct requirement coefficients for changes in technology, the 1947 national input coefficient matrix was compared with the 1958 national input coefficient matrix with respect to several sectors.[4] Any changes in the size of the input coefficients were assumed to be due to technology since for all practical purposes the national economy can be viewed as a closed economy. If any coefficient had changed during the period, then the same coefficient for the Nebraska model was adjusted to reflect this change.

[2] This method is described in M. David Beveridge, *The Construction of Input-Output Tables for the Nebraska Economy of 1958* (An unpublished thesis on deposit in the University of Nebraska Library, Lincoln, Nebraska).

[3] Furthermore, the question of the tenability of the assumptions used in this method has been the subject of innumerable discussions.

[4] Several sectors appearing in the 1947 and 1958 National Input-Output Models were aggregated to make both models comparable with the 1963 Nebraska Input-Output Model.

Once all coefficients were adjusted for changes in technology, a second round of adjustments was required in order to account for changes in trade patterns between 1947 and 1963. Location quotients were used to make this adjustment. Location quotients are frequently used, at least on a preliminary basis, to study a region's export-import relations.[5] A location quotient for each sector was computed by dividing (1) the state's share of the national total of employees for a given sector by (2) the state's share of total employment. These coefficients show if a state has more or less than its proportionate share of an activity relative to the nation.

If the location quotient for a sector is greater than unity, this indicates that the state does in fact have a proportionately larger share than the nation. It was assumed that the sectors whose location quotients exceeded unity were export sectors, and those whose location quotients were below unity were import sectors. Changes in the location quotients for each sector between 1947 and 1963 were assumed to reflect changes in import and export patterns. Thus a final round of adjustments was made according to the way the location quotients for each sector varied during this period.

After the Direct Requirements Table for 1963 had been adjusted, as just described, to reflect the 1947 economy, a total requirements table and the output multipliers for the two crop sectors were computed. These two multipliers are given in the 1947 row of Table 5.2. With respect to the estimating procedure utilized, it should be noted that the assumption of the relationship between changing location quotients and trade patterns is open to serious objections. For purposes of estimating output multipliers for Irrigated and Dryland Crops, however, this procedure appeared on the surface to be very conservative. In other words, these estimated output multipliers for 1947 appear to be understated.

In order to estimate output multipliers for the years 1946 through 1965, it was assumed that these multipliers were changing gradually along a straight-line trend which passed through the 1947 and 1963 values of the multipliers. Because the differences between the 1947 and 1963 values are small and because technological changes might be expected to occur gradually, the assumption of linear change does not appear unreasonable. On this assumption values for the other years in the period were estimated. These are given in Table 5.2.

TABLE 5.2
Estimated Output Multipliers for Irrigated and Dryland Crops in Nebraska, 1946-65

Year	Irrigated Crops	Dryland Crops
1946	2.09425	1.83458
1947	2.09755	1.83909
1948	2.10085	1.84360
1949	2.10414	1.84811
1950	2.10744	1.85262
1951	2.11073	1.85714
1952	2.11403	1.86165
1953	2.11732	1.86616
1954	2.12062	1.87067
1955	2.12391	1.87518
1956	2.12721	1.87969
1957	2.13051	1.88420
1958	2.13380	1.88871
1959	2.13710	1.89322
1960	2.14039	1.89774
1961	2.14369	1.90225
1962	2.14698	1.90676
1963	2.15028	1.91127
1964	2.15358	1.91578
1965	2.15687	1.92029

Source: A straight-line trend was assumed to pass through the 1947 and 1963 values which were estimated from input-output models.

The multipliers shown in Table 5.2 are expressed to six significant digits. It should be kept in mind that these are estimates whose accuracy to six significant digits could hardly be supported. While numbers with more than three or four significant digits are frequently used in this study in estimating impact, it is suggested that these be rounded to three or four significant digits when reference is made to these individually. More significant digits are frequently indicated because these numbers may be used in further computations. In such cases the rounding to three or four significant digits should occur after the computations.

By applying the irrigated output and dryland output multipliers of Table 5.2 to the yearly data given in Table 5.1, the current induced-by effects of Irrigated Crops were estimated. The final results along with some of the intermediate results are given in Table 5.3. First the irrigated outputs given in Table 5.1 were multiplied by the irrigated output multipliers given in Table 5.2 for each year. The results are recorded in column 2 of Table 5.3 as the total requirements of the Irrigated Crops Sector. The same method was used to obtain the total requirements of the dryland equivalents given in column 3 of Table 5.3.

Because of the nature of the multipliers used, the total requirements given in columns 2 and 3

[5] Walter Isard, *Methods of Regional Analysis* (Cambridge, The M. I. T. Press, 1966), p. 123.

of Table 5.3 include both the current direct and the current induced-by effects. To obtain the current induced-by effects, the current direct effects must be subtracted from the total requirements. Thus the current induced-by effects given in columns 4 and 5 of Table 5.3 are the result of subtracting the irrigated output and the dryland equivalent columns of Table 5.1 from the corresponding total requirements columns of Table 5.3. Now the current induced-by effects of the dryland equivalents must be subtracted from the current induced-by effects of the outputs of Irrigated Crops to obtain the *net* current induced-by effects due solely to irrigated farming.

The net current induced-by effects represent the additional current economic activity (gross income and output) of the state induced by the additional crop production made possible through the use of irrigation and the package of resources accompanying it. These benefits which were about 50 million dollars in 1946 have more than tripled on a yearly basis in the postwar period.

THE CURRENT STEMMING-FROM EFFECTS

The current stemming-from effects refer to the economic activity generated by the processing of the net increases in crop production due to irrigation. For example, as the production of corn increases, the Nebraska industries processing corn may expand their level of production and consequently increase their sales to an expanding external market. Furthermore, it is conceivable that the crop processing sectors can expand production without increasing the size of their operation; that is, there may exist within the crop processing plants excess capacity that can handle small increases in crop production during any one production period. This, of course, will create pressure to increase capacity within the processing sectors.[6] It is the objective in this section to estimate the economic activity involved in processing the net increases in crop production due to irrigation.

TABLE 5.3

Derivation of Induced-by Effects of Irrigated Crops in Nebraska, 1946-65

Year	Total Requirements		Induced-by Effects		
	Irrigated Crops	Dryland Equivalents	Irrigated Crops	Dryland Equivalents	Net
(1)	(2)	(3)	(4)	(5)	(6)
	(thousands of dollars)				
1946	$124,828	$ 32,151	$ 65,223	$14,626	$ 50,597
1947	150,354	47,629	78,673	21,731	56,942
1948	126,650	47,157	66,365	21,578	44,787
1949	123,004	44,841	64,546	20,578	43,968
1950	145,582	55,695	76,502	25,632	50,870
1951	148,462	54,982	78,125	25,376	52,749
1952	173,995	55,300	91,690	25,595	66,095
1953	176,805	43,840	93,301	20,348	72,953
1954	191,023	50,355	100,944	23,437	77,507
1955	215,989	36,000	114,295	16,802	97,493
1956	285,776	33,616	151,433	15,732	135,701
1957	317,812	114,731	168,640	53,840	114,800
1958	322,131	133,554	171,165	62,842	108,323
1959	345,723	129,464	183,951	61,081	122,870
1960	355,052	121,560	189,170	57,505	131,665
1961	359,951	122,941	192,039	58,312	133,727
1962	355,377	153,633	189,853	73,060	116,793
1963	414,828	136,226	221,910	64,951	156,959
1964	430,109	129,166	230,391	61,744	168,647
1965	448,616	160,277	240,622	76,812	163,810

Source: Computed as described in the accompanying text.

Before attempting to measure the current stemming-from effects of irrigation, it may be useful to review briefly one theory of regional growth. Certain industries are basic to a region in the sense that these industries are primarily serving, either directly or indirectly, markets located outside the region. The phrase "directly or indirectly" requires clarification. An industry, such as agriculture, can sell directly to buyers located outside the region. On the other hand, agriculture can sell to processing industries located in the region who in turn sell directly to buyers outside the region. In this second case, agriculture would be serving indirectly markets located outside the region. In either situation, the growth of the industry is primarily determined by the growth of external markets. Thus the development of the region depends on the growth of the export-type industries.

As indicated in the introduction of this chapter, agriculture can be classified as an export base industry for Nebraska. Applying the export base concept to Nebraska crop production, it is evident from the 1963 Nebraska Transactions Table that a large percentage of the total crop production was used either directly or indirectly to support Nebraska's total volume of sales to Final Demand. The sales to Final Demand for those sectors closely linked to crop production are summarized in Table 5.4. These sectors include: (1) Livestock and Livestock Products, (2) Meat Products, (3) Dairy Products, (4) Grain Products, and (5) Other Foods. Three of these processing sectors buy products directly from the crop producing sectors and process these inputs. The other two sectors, Meat Products and Dairy Products, buy the product to be processed from Livestock Products which in turn buys crops for feed. Thus the Meat Products and Dairy Products Sectors are two stages removed from the crop producing sectors. The data in Table 5.4 show

[6] The economic impact associated with capital investments is discussed at the close of this chapter and in Appendix A.

TABLE 5.4

Total Nebraska Crop Requirements Associated with Output to Final Demand for Each Processing Sector in 1963

Sector (1)	Total Sales to Final Demand by Processing Sector ($1,000) (2)	Total Crop Requirement per $1 Sales to Final Demand (In Dollars) (3)	Total Crop Requirement ($1,000) (4)	Total Crop Requirement as % of Total Crop Output (5)
Livestock and Livestock Products	$ 45,336	$0.23910	$ 10,840	1.554
Meat Products	820,157	0.15060	123,516	17.706
Dairy Products	52,829	0.16255	8,587	1.231
Grain Products	149,809	0.51482	77,125	11.056
Other Foods	144,408	0.08998	12,994	1.863

Source: The Final Demand column was obtained from Table C.1. The total crop requirements per dollar of output to Final Demand were obtained from Table C.3. The other data were computed as described in the accompanying text.

that more of Nebraska crops leave the state in the form of meat products than in any other processed form.

As an illustration of how the figures in Table 5.4 were derived, the steps in computing the crop requirement for Grain Products in 1963 are as follows: The Nebraska Transactions Table (Table C.1) shows that the Grain Products Sector sold $149.809 million to Final Demand in 1963. In addition, the Total Requirements Table (Table C.3) shows that approximately 51 cents of crop production activity was associated with each dollar of sales by the Grain Products Sector to Final Demand. (This is found by summing the Irrigated and Dryland Crops requirements in the Grain Products column of Table C.3). To find the total amount of crop production grown in Nebraska and associated with the total sales to Final Demand by the Grain Products Sector, the 51 cents (0.51482) is multiplied by the $149.809 million (Grain Products sales to Final Demand in 1963.) The resulting figure of $77.125 million in column 4 of Table 5.4 is then expressed as a percentage of the total value of crop output in 1963. This estimate is 11.056 per cent and is shown in column 5 of Table 5.4. The same procedure was used to compute the total crop requirements for the other crop processing sectors in Table 5.4.

When the Dryland and Irrigated Crops requirements are summed to arrive at a total crop requirement, this implies that there is perfect substitution between Irrigated and Dryland Crops. In other words, the Grain Products Sector (and other sectors indirectly involved in Grain Products' sales to Final Demand) are assumed to be indifferent as to whether the crop output was grown on irrigated land or under dryland conditions. This assumption was made in order to estimate the current stemming-from effects associated with irrigation. It does not appear to be too unrealistic in most instances. In the case of sugar beets, however, it is unlikely that sugar beet production would take place under dryland conditions in Nebraska. The result is an understatement of the stemming-from effects associated with irrigation within the sugar beet industry which is included in Other Foods.

To measure the current stemming-from effects associated with irrigation, the *net* increases in crop production due to irrigation (Table 5.1) were used to allow for the stemming-from effects that would be associated with the crop output equivalent to dryland production. In other words, the current stemming-from effects would be over stated if the total irrigated crop output for a production period were used.

One can identify the parts of the net increases in crop production which were associated with the sales to Final Demand via the crop processing sectors. This can be accomplished by multiplying the net increases shown in Table 5.1 by the percentages in column 5 of Table 5.4. As an illustration, part of the total crop requirements for the Grain Products Sector is assumed to come from the net increases in crop production due to irrigation. In fact, approximately 11 per cent of the net increase due to irrigation was associated with the Grain Products' sales to Final Demand in 1963.

In order to apply the information in Tables 5.1 and 5.4 over a period of years, the sales patterns of the crop processing sectors as well as the input structure of the economy would have to remain stable. While this could hardly be assumed to be the case for the entire postwar period, the assumption of stable trade and input patterns should be applicable for the 1960's. The agricultural sectors in the 1963 Nebraska Transactions Table were constructed using three-year averages. Thus the sales and input patterns for the agricultural sectors and the closely associated crop processing sectors of agriculture's output ought to be representative of the period from 1960 to 1965.

Table 5.5 shows the movement of the net increase in crop output to Final Demand via the major crop processing sectors from 1960 to 1965.[7] The net increases in crop production were broken down in terms of crop requirements based on the percentages shown in column 5 of Table 5.4. For example, in 1963, $13.449 million of the net increase in crop

[7] The reader should note that the movement of crop output shown in Table 5.5 does not account for the total net increase in crop output for a given year since some crop production moves directly to Final Demand.

TABLE 5.5

Net Increases in Crop Output Associated with Each Crop Processing Sector's Sales to Final Demand, 1960-65

Year (1)	Net Increase in Crop Output (2)	Net Increase Associated with: Livestock & L.S. Products (3)	Meat Products (4)	Dairy Products (5)	Grain Products (6)	Other Foods (7)
	(thousands of dollars)					
1960	$101,827	$1,582	$18,029	$1,253	$11,258	$1,897
1961	103,290	1,605	18,289	1,271	11,420	1,924
1962	84,951	1,320	15,041	1,046	9,392	1,583
1963	121,643	1,890	21,538	1,497	13,449	2,266
1964	132,296	2,056	23,424	1,629	14,627	2,456
1965	124,529	1,935	22,049	1,533	13,768	2,320

Source: The net increases were obtained from Table 5.1. The other data were obtained by multiplying the percentages obtained from Table 5.4 by the net increases in crop output for the years 1960 to 1965.

production was associated with Grain Products' sales to Final Demand ($121.643 million x 0.11056 = $13.449 million).

Obviously, the crop requirements in Table 5.5 are only part of the total crop requirements associated with the total level of sales to Final Demand by each of the processing sectors. The reader can verify this by referring to column 4 of Table 5.4. The question then is what fraction of the total volume of sales to Final Demand by each crop processing sector was supported by the crop requirements shown in columns 3 through 7 of Table 5.5. This can be estimated for each crop processing sector with the use of the following relationship:

$$r_j/d_j = R_j/D_j$$

where

r_j = total requirements of crop production associated with a dollar of sales to Final Demand by crop processing sector *j*. (Column 3 of Table 5.4; also Table C.3).

d_j = a dollar of sales to Final Demand by crop processing sector *j*.

R_j = total requirements of crop production due to irrigation and associated with the sales to Final Demand by crop processing sector *j* (Table 5.5).

D_j = that level of sales to Final Demand by crop processing sector *j and* supported by irrigation.

An illustration of the use of this relationship for the Grain Products Sector in 1963 is as follows:

r_j = 0.51482 (from column 3 of Table 5.4)

d_j = $1.00

R_j = $13.449 million (from Table 5.5)

D_j = the unknown (the level of trade to Final Demand by the Grain Products Sector and supported by irrigation).

Thus, 0.51482/$1.00 = $13.449 million/$D_j$.

Solving for D_j gives

D_j = $13.449 million/0.51482 = $26.124 million.

Thus the $13.499 million of the net increase in crop output (from the Irrigated Crops Sector) was associated, directly or indirectly, with $26.124 million of sales to Final Demand by the Grain Products Sector. These two amounts are indicated in columns 2 and 3 of the Grain Products section of Table 5.6 for the year 1963. By means of the same general relationship and the appropriate values for r_j and R_j, the other entries in column 3 of this table were computed. The entries in column 2, the R_j values, were obtained from Table 5.5.

In addition to the requirements imposed upon crop production by Grain Products' sales to Final Demand, other requirements had to be met to enable Grain Products to sell to Final Demand. To review, the final demand multiplier of sector *j* is a measure of the total activity necessary to support one dollar of sales to Final Demand by sector *j*.

TABLE 5.6

Estimated Final Demand and Total Economic Activity Associated with Net Increase in Crop Output, by Major Processing Sectors, 1960-65

Year (1)	Associated Net Increase in Crop Output (2)	Final Demand Supported By Associated Net Increase in Crop Output (3)	Total Activity Associated with Estimated Final Demand (4)
	(thousands of dollars)		
Livestock and Livestock Products			
1960	$ 1,582	$ 6,616	$ 18,249
1961	1,605	6,713	18,516
1962	1,320	5,521	15,228
1963	1,890	7,905	21,804
1964	2,056	8,599	23,718
1965	1,935	8,093	22,323
Meat Products			
1960	18,029	119,715	379,261
1961	18,289	121,441	384,729
1962	15,041	99,874	316,404
1963	21,538	143,015	453,076
1964	23,424	155,538	492,749
1965	22,049	146,408	463,825
Dairy Products			
1960	1,253	7,708	25,291
1961	1,271	7,819	25,655
1962	1,046	6,435	21,114
1963	1,497	9,209	30,216
1964	1,629	10,022	32,884
1965	1,533	9,431	30,945
Grain Products			
1960	11,258	21,868	57,410
1961	11,420	22,183	58,237
1962	9,392	18,243	47,893
1963	13,449	26,124	68,583
1964	14,627	28,412	74,589
1965	13,768	26,743	70,208
Other Food			
1960	1,897	21,082	39,717
1961	1,924	21,383	40,284
1962	1,583	17,593	33,144
1963	2,266	25,183	47,443
1964	2,465	27,395	51,611
1965	2,320	25,784	48,576

Source: Column 2 was obtained from Table 5.5. Columns 3 and 4 were computed as described in the accompanying text.

Multiplying the final demand multiplier for the Grain Products Sector by the sales of Grain Products to Final Demand (supported by a portion of the net increase in crop output) gives the total activity (gross output) required to support this level of trade.[8] Thus

(2.62528) (26.124) = 68.583 or $68.583 million.

This total activity estimate of $68.583 million is recorded in column 4 of the Grain Products section of Table 5.6 for the year 1963. The other entries of column 4 were computed in the same manner using the appropriate final demand multipliers of the crop processing sectors and the information in column 3 of Table 5.6.

The total requirements shown in column 4 of Table 5.6 include the current direct, current induced-by, and current stemming-from effects of irrigation. For example, the total requirement of $68.583 million, which was computed above for the Grain Products Sector, includes the original $13.449 million of the net increase in crop production. Furthermore, as already shown in the earlier section of this chapter, certain current induced-by effects were associated with the $13.449 million of crop production and these effects are also included in the $68.583 million figure.

In order to measure the current stemming-from effects, the current direct and current induced-by effects must be subtracted out of the $68.583 million. The current direct and current induced-by effects may be estimated by simply multiplying the original figure of $13.449 million (the additional crop production due to irrigation) by the output multiplier for Irrigated Crops. As computed in Chapter IV the output multiplier for Irrigated Crops was 2.15028 in 1963. The result, $28.919 million, is a measure of the current direct and current induced-by effects of irrigation. These estimates are recorded in column 4 of Table 5.7. Subtracting this computed value from the original value of $68.583 million gives an estimate of the current stemming-from effects associated with irrigation within the Grain Products Sector. This estimate is $39.664 million. Column 5 of Table 5.7 shows the current stemming-from effects associated with the additional crop production attributed to irrigation for each of the major crop processing sectors. The current stemming-from effects associated with irrigation were computed for the period from 1960 to 1965. The other columns in Table 5.7 give the pertinent data needed to estimate the current stemming-from effects.

The current stemming-from effects should be interpreted with care and caution. To clarify this statement an illustration will be used. In 1963 approximately $21.538 million of the net increase in crop production was associated with $143.015 million of sales to Final Demand by the Meat Products Sector (columns 2 and 3 of Table 5.6). Applying the final demand multiplier to the $143.051 million shows that $453.076 million (column 4 of Table 5.6) of total current economic activity (gross output) was required in order that Meat Products could sell this amount to Final Demand. Now, in referring back to the original $21.538 million of additional crop production due to irrigation, $46.313 million (column 4 of Table 5.7) of econom-

TABLE 5.7

Estimated Stemming-from Effects Associated with Irrigated Crops for the Period 1960-65, by Major Processing Sector

Year (1)	Total Activity Associated With Estimated Final Demand (2)	Associated Net Increase of Crop Output (3)	Direct and Induced-by Effects (4)	Stemming-from Effects (5)
	(thousands of dollars)			
Livestock and Livestock Products				
1960	$ 18,249	$ 1,582	$ 3,402	$ 14,847
1961	18,516	1,605	3,451	15,065
1962	15,228	1,320	2,838	12,390
1963	21,804	1,890	4,064	17,740
1964	23,718	2,056	4,421	19,297
1965	22,323	1,935	4,161	18,162
Meat Products				
1960	379,261	18,029	38,767	340,494
1961	384,729	18,289	39,326	345,403
1962	316,404	15,041	32,342	284,062
1963	453,076	21,538	46,313	406,763
1964	492,749	23,424	50,368	442,381
1965	463,825	22,049	47,412	416,413
Dairy Products				
1960	25,291	1,253	2,694	22,597
1961	25,655	1,271	2,733	22,922
1962	21,114	1,046	2,249	18,865
1963	30,216	1,497	3,219	26,997
1964	32,884	1,629	3,503	29,381
1965	30,945	1,533	3,296	27,649
Grain Products				
1960	57,410	11,258	24,208	33,202
1961	58,237	11,420	24,556	33,681
1962	47,893	9,392	20,195	27,698
1963	68,583	13,449	28,919	39,664
1964	74,589	14,627	31,452	43,137
1965	70,208	13,768	29,605	40,603
Other Food				
1960	39,717	1,897	4,079	35,638
1961	40,284	1,924	4,137	36,147
1962	33,144	1,583	3,404	29,740
1963	47,443	2,266	4,873	42,570
1964	51,611	2,465	5,300	46,311
1965	48,576	2,320	4,989	43,587

Source: Columns 2 and 3 were obtained from Table 5.6. Column 4 was obtained by multiplying column 3 by the output multiplier for Irrigated Crops, 2.15028. Column 5 is column 2 minus column 4.

[8] The 1963 final demand multipliers for each of the processing sectors, given in Table C.3, were used to compute the total requirements for each year. This was consistent with the assumption of constant trade patterns and input structure for the Nebraska economy.

ic activity (gross output) was required in order to produce the $21.538 million of crop output—the output multiplier for Irrigated Crops (2.15028) times $21.538 million of additional crop production. This leaves a difference (subtracting $21.538 million from $453.076 million) of $406.763 million which has been defined as the current stemming-from effects of irrigation. The major question now is this: Does the method of measuring the current stemming-from effects show that this amount of additional activity ($406.763 million) was made possible only by irrigation? The answer is no, and the reasons for this conclusion are given below.

The current stemming-from effects refer only to the amount of economic activity via the crop processing sectors and their suppliers which *is associated with* the net increase in crop production due to irrigation. A cause-and-effect relationship is not implied by this terminology. While there may be something close to such a relationship in some stemming-from situations, the measurement technique used here does not shed light on this. In other words, the figures cited in the preceding paragraph do not mean that if the additional crop production of $21.538 million, due to irrigation, had not been available to the Meat Products Sector (via livestock production), the sales to Final Demand by Meat Products would have decreased by $143.051 million. It is conceivable that (a) the additional feed required to support the total sales to Final Demand by the Meat Products Sector in 1963 (via livestock) could have been imported; (b) the additional feed could have come from Dryland Crops, thus reducing their exports; (c) the import of slaughter cattle could have increased in order to support the 1963 level of sales of meat products to Final Demand; or (d) some combination of the above factors could have maintained the 1963 Nebraska sales of meat products to Final Demand.

While there is some doubt as to the cause-and-effect relationship associated with the Meat Products Sector, a stronger argument for a cause-and-effect relationship can be made for the Other Foods Sector. The 1963 Nebraska Transactions Table shows that Irrigated Crops sold $17.988 million to Other Foods. Approximately 93 percent of this was sugar beets going to the sugar beet processors which have been included in the Other Foods Sector. Also noted from the Transactions Table is that Dryland Crops sold only $756 thousand to Other Foods. Thus, there is some indication, at least from the 1963 Transactions Table, that purchases by the Other Foods Sector from crop production grown in Nebraska would be quite small if it were not for the production of sugar beets. In addition, the sugar beet processing plants probably would not be located in Nebraska if it were not for the production of sugar beets.

The current stemming-from effects noted in column 5 of Table 5.7 have been aggregated for each year in Table 5.8. These are estimates of the current economic activity generated in the processing of the products of Irrigated Crops as they move to Final Demand by way of the crop processing sectors. The total current stemming-from effects of the three one-stage processing sectors is given for each year. These are the crop processing sectors which buy products directly from Irrigated Crops, process these products, and then sell to one or more of the Final Demand sectors. Of these three, the Other Food Products Sector ranks highest in current stemming-from effects, even though this category is probably underestimated, for reasons noted earlier. Sugar beet processing accounts for most of this sector's activities. Grain Products ranks second and Livestock Products third.

Livestock Products ranks low here because its current stemming-from effects include only those

TABLE 5.8

Aggregated One-Stage, Two-Stage, and Total Stemming-from Effects, 1960-1965

Processing Sector	1960	1961	1962	1963	1964	1965
	(thousands of dollars)					
One-Stage Processing						
Livestock and Livestock Products	$ 14,847	$ 15,065	$ 12,390	$ 17,740	$ 19,297	$ 18,162
Grain Products	33,202	33,681	27,698	39,664	43,137	40,603
Other Food Products	35,638	36,147	29,740	42,570	46,311	43,587
Stemming from Effects of One-Stage Processing	83,687	84,893	69,828	99,974	108,745	102,352
Two-Stage Processing						
Meat Products	340,494	345,403	284,062	406,763	442,381	416,413
Dairy Products	22,597	22,922	18,865	26,997	29,381	27,649
Stemming from Effects of Two-Stage Processing	363,091	368,325	302,927	433,760	471,762	444,062
Total Stemming from Effects	446,778	453,218	372,755	533,734	580,507	546,414

Source: Table 5.7.

activities associated with its exports from the state and these are a small proportion of its total output. Most of its product is sold to the domestic Meat Products Sector which processes and then exports most of its product. Thus, associated with the Meat Products Sector there is in effect a two-stage processing of crop products, including first the processing by Livestock Products and then the processing by Meat Products. Similarly the Dairy Products Sector is also part of a two-stage processing of crop output.

The current stemming-from effects associated with movement to Final Demand through the two-stages of processing are estimated in the current stemming-from figures for Meat Products and Dairy Products in Table 5.8. The current stemming-from effects for the Meat Products Sector are very high relative to the other categories (1) because more of the net increase of Irrigated Crops products is processed through this route than any other, (2) because Meat Products exports a large volume from the state in absolute terms and relatively, and (3) because the required activities in both the Livestock Products and the Meat Product Sectors are included here.

As for the overall current stemming-from totals, considerable variation is evident, even for this short period. In recent years, however, such activity has totaled well over $500 million. In interpreting these estimates, it is worth mentioning again that it cannot be claimed on the basis of the foregoing analysis that the activities being measured were necessarily caused by irrigation; but they were *associated with* the products of irrigated agriculture to the extent that the assumptions used in the analysis are realistic.

INVESTMENT IMPACT

Investment impact can be separated into (a) direct investment impact and (b) indirect investment impact. The terms "direct" and "indirect" are used here in the same way they were used to describe the current impact of irrigation.

The *direct investment impact* refers to the activity which is generated in the internal economy by the direct investments in irrigation. These direct investments refer to the capital expenditures required to provide and distribute the water supply used for irrigation and to the additional farm machinery used.

The indirect investment impact, comparable to the current indirect impact, can be further separated into induced-by effects and stemming-from effects. The *indirect induced-by effects* refer here to the capital growth of those sectors that directly or indirectly (a) supply materials and services necessary for the growth of the Irrigated Crops Sector, and (b) supply inputs which are required to produce the net increase in crop output associated with irrigation. In contrast, the *indirect stemming-from effects* refer to the growth in the crop processing sectors, which is primarily a result of the net increase in crop output, and/or growth in those sectors that supply inputs to the crop processing sectors (excluding the crop producing sectors).

Since the *total* investment impact of the Irrigated Crops Sector was not measured in this study, it is not necessary to have a lengthy treatment of each of the various types of investment impacts.[9] The reason *total* investment impact was not empirically measured is discussed later. A brief discussion of the various types of investment impact follows.

In terms of acres the Irrigated Crops Sector has grown at the expense of the Dryland Crops Sector. The number of acres under irrigation, as noted in Chapter I, has more than tripled in the last twenty years. The growth of irrigation has not only required new investments in capital within the Irrigated Crops Sector, but it has also created pressure for the expansion of those sectors supplying capital equipment to Irrigated Crops. For instance, the adoption of irrigation practices opened a market for various establishments within the state producing some of the equipment necessary in the transportation and distribution of water. As an illustration, approximately 99 percent of the gated pipe and sprinkler systems sold in Nebraska are manufactured in Nebraska.[10]

The Construction Sector has also shared in the growth of irrigation. In 1963, approximately 737,000 acres of cropland were irrigated from surface type sources in contrast to wells. This represented approximately 27 per cent of the total number of acres under irrigation in Nebraska for 1963.[11] Associated with the surface type system is the construction of reservoirs and canals. This activity has had some effect on the growth of the Construction Sector in Nebraska. Also, the drilling of irrigation

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[9] Appendix A, however, is devoted to the construction of a simulation model. One of the purposes of the construction of this model was to measure the direct investment impact associated with the movement of a block of land from the Dryland to the Irrigated Crops Sector.

[10] These estimates were obtained through interviews with the producers of irrigation equipment in Nebraska, and the Agricultural Engineering Department at the University of Nebraska.

[11] These estimates were computed from irrigation data reported in Nebraska Department of Agriculture and Inspection, *Nebraska Irrigation Statistics*,

wells has increased the demand for construction activity. In addition to the increased demand for capital equipment and for the construction works of which irrigation systems are composed, additional investment effects may occur in those sectors supplying materials and services for current irrigated crop production. For instance, the demand for fertilizer should increase as the Irrigated Crops Sector expands production. Some of this increase in demand may be supplied from the expansion of already existing facilities in Nebraska. Moreover, new fertilizer plants may be located within the state. The growth in these kinds of activities just described, which are associated with crop production and irrigation, are referred to in this study as induced-by investment impacts.

As already noted, the stemming-from effects are associated with the growth in the capacity of the crop processing sectors which is primarily a result of the increase in crop production. Conceivably, the growth in the level of output from Irrigated Crops (and possibly Dryland Crops) has made it possible for the crop processing sectors to increase their operations. As an illustration, in the Central Nebraska Public Power and Irrigation District the value of livestock production has increased approximately 128 per cent between the years 1948 and 1963. The increase for the state was approximately 96 per cent.[12] This seems to suggest that the rapid increase in the feed supply, due to irrigation, has enabled a higher rate of growth in the livestock enterprise for the same area. A second example of the stemming-from investment effects is the growth of the sugar beet processing establishments in the state. If it were not for the production of sugar beets in the state, the sugar beet processing plants would probably not be located in Nebraska.

To measure the total investment impact on the economy resulting from the growth of irrigation requires the construction of a dynamic input-output model. The Nebraska Transactions Table is referred to in the literature as a static model. The static input-output model assumes that the structure of the economy is fixed. In other words, it does not consider investments and how investments affect the structure of the economy. However, an input-output model can conceivably be constructed so that structural change, through investments, can be measured; that is, investment decisions are made an endogenous part of the model. The lack of sufficient investment data either at the firm level or industry level precludes this possibility, at least at the present time.

In Appendix A an attempt has been made to trace the effects on the economy resulting from the direct investments in the Irrigated Crops Sector (which includes capital expenditures required to supply and distribute the water used in irrigation.) This was done by using the 1963 Nebraska input-output model. Even though the model can not generate the amount of investment activity occurring in other sectors, due to the growth in Irrigated Crops, it does show the need for expansion in the operations of those sectors supplying materials to agriculture and also those sectors processing agriculture's output.

SUMMARY

The foregoing analysis can best be summarized by first focusing on a single production year in order to distinguish between the different types of current economic effects. This is done in Chart 5.2 and Table 5.9. Secondly, the change in the magnitude of the current economic effects of irrigation during the post-war period is summarized in Chart 5.3.

Chart 5.2 shows the current economic effects of a net increase in irrigated crop output for 1963. The twenty-three endogenous sectors (the 1963 Nebraska Transactions Table) have been combined in order to trace the different types of current economic effects associated with a net increase in crop output due to irrigation. The chart shows flows from left to right. In addition, Chart 5.2 shows (a) the current economic effects of a one dollar net increase in crop output, and (b) the current economic effects of a net increase in output per acre. The current economic effects on a per dollar basis are shown in parentheses while the current economic effects on a per acre basis are shown in brackets.[13] A discussion of the current economic effects computed on a per dollar and per acre basis follows the general discussion of the current economic effects due to the net increase in crop output of $121:643 million for 1963.

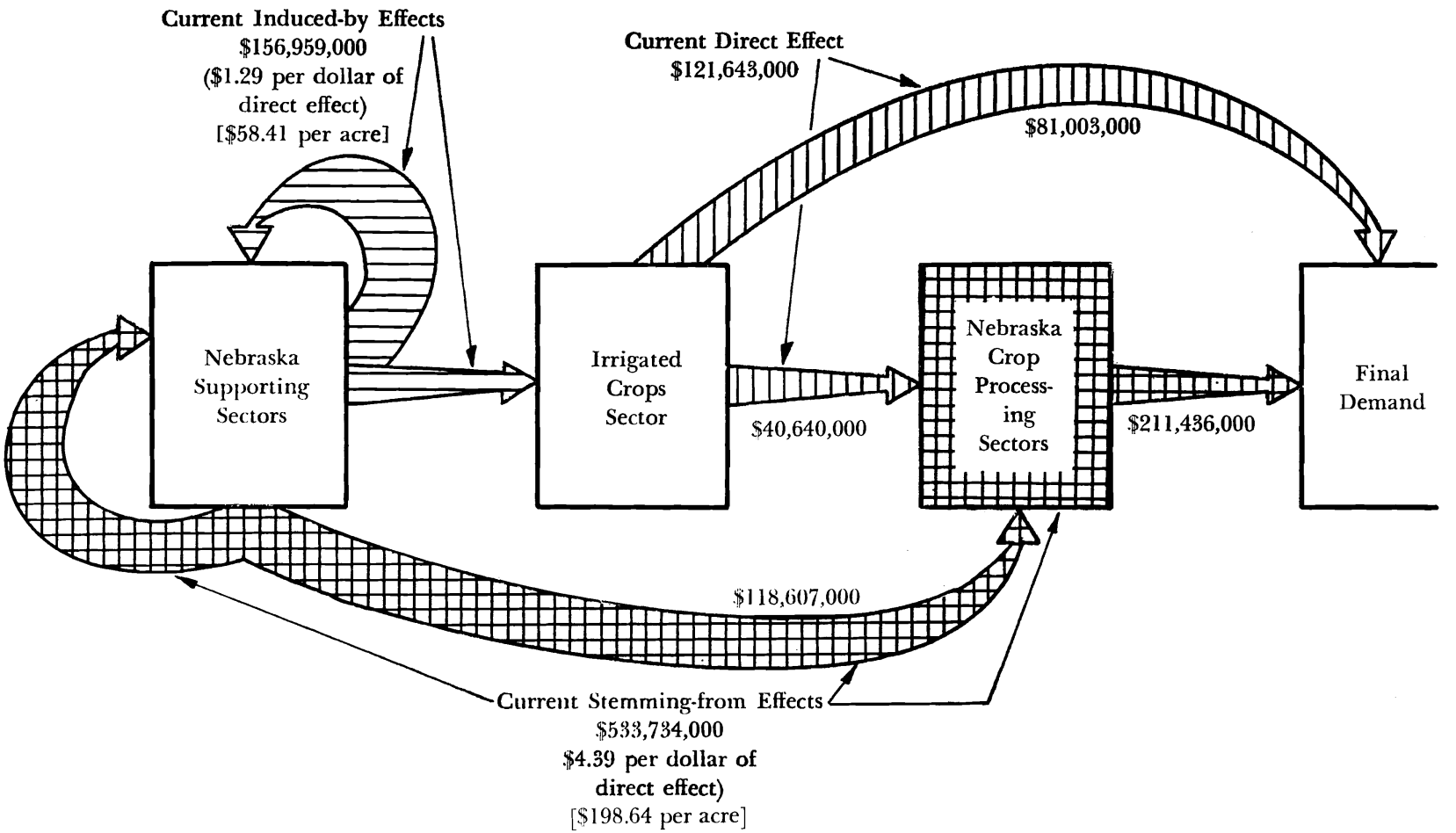
In 1963, the total value of irrigated crop output was approximately $192.918 million, and the total number of irrigated acres was approximately 2.687 million acres. It was estimated that approximately $71.275 million of crop output could have been

[12] Nebraska Department of Agriculture and Inspection, *Nebraska Agricultural Statistics, Annual Report for 1963 and 1964*.

[13] The different types of current economic effects computed on a per dollar and a per acre basis reflect the economic structure, prices, and yields in Nebraska for 1963.

CHART 5.2

The Current Economic Effects of an Increase in Crop Production due to Irrigation in Nebraska in 1963



Source: The data were taken directly from Tables 5.1, 5.3, 5.7, and 58 or were computed from data in these tables and Table C.2.

grown on the 2.687 million acres under dryland conditions.[14] Therefore it was assumed that the net differences of $121.643 million of crop output was due to irrigation. This net difference has been defined as the *current direct effect* of irrigation. The net increase of $121.643 million is shown above the frame for the Irrigated Crops Sector in Chart 5.2. From the flow chart it is possible to identify the current induced-by and current stemming-from effects associated with the net increase in crop output.

In order to support the net increase of $121.643 million of crop output, certain input requirements were necessary. The spending and respending activity associated with the production of the input requirements from the Nebraska supporting sectors plus the direct input requirements to Irrigated Crops have been defined as the *current induced-by effects* of irrigation. The total of these transactions is shown above the frame for the Nebraska supporting sectors in Chart 5.2. This total is $156.959 million.

Chart 5.2 shows that approximately $40.64 million of the net increase in crop output was processed in Nebraska before moving to Final Demand. This supported $211.436 million of the total sales by the Nebraska crop processing sectors to Final Demand. However, in order for the crop processing sectors to sell $211.436 million of processed crops to Final Demand, additional input requirements besides the direct crop inputs were required. In fact, as Chart 5.2 indicates, approximately $118.607 million of additional inputs were purchased from the Nebraska supporting sectors. Furthermore, it should be kept in mind that input requirements, which are not shown in Chart 5.2, were also imported. For example, in 1963 the Other Foods Sector imported over 50 per cent of its total input requirements. The per cent of imported input requirements, however, was much lower for other Nebraska crop processing sectors. The total *current stemming-from effects* which are associated with irrigation for the year 1963 are shown in the lower part of Chart 5.2 and estimated as $533.734 million. The total current stemming-from effects include the transactions activity which loops back upon the frame of the Nebraska supporting sectors, the transactions flow to the Nebraska food processing frame, and the activity within the Nebraska crop processing frame. It should be kept in mind, however, that the direct crop input of $40.64 million and the transactions activity associated with this direct input have been subtracted out in order to avoid counting the current direct and current induced-by effects twice.

As already indicated, Chart 5.2 also shows the different types of current economic effects on a per dollar and on a per acre basis. To repeat, the different types of current economic effects computed on a per dollar basis are shown in parentheses. In contrast, the different types of current economic effects based on a net increase in crop output per acre are shown in brackets. An explanation of the estimated current economic effects based on a per dollar or a per acre basis is not necessary since it would not differ from the above general explanation of the current economic effects associated with a net increase in crop output of $121.643 million. The reader, however, can use the information contained in the parentheses to compute the current economic effects associated with any given level of net increase in crop output. For instance, the current stemming-from effects associated with a net increase in crop output of $1,000 would be $4,390 ($1,000 x $4.39). Similarly, the current economic effects associated with any given number of irrigated acres can be estimated from the information given in the brackets.

It may be of interest to the reader to know what supporting sectors were effected most by the net increase in crop output of $121.643 million. Chart 5.2 shows that the total of the current induced-by effects, which was due to the net increase in crop output of $121.643 million, was $156.959 million. How is this total of current induced-by effects assigned to each of the endogenous sectors? It is possible to trace the current induced-by effects of irrigation upon each of the endogenous sectors through the use of the Total Requirements Table. The results are provided in Table 5.9. The importance of this table is in providing the reader with a picture of the relative size of the current induced-by effects upon each endogenous sector within the Nebraska economy. As the table clearly indicates, the Household Sector was effected most by the net increase in crop output of $121.643 million.

No attempt is made to show the current stemming-from effects on each supporting sector in Table 5.9. The reason for this omission is the illusiveness of the actual economic effects upon a supporting sector which stem from a net increase in crop output. This problem was discussed earlier in this chapter.

[14] Source: Tables 5.1 and 5.9.

TABLE 5.9

Current Induced-by Effects of Irrigation Upon the Twenty-Three Endogenous Sectors of Nebraska, 1963

Sectors	Current Induced-by Effects ($1,000's)
Livestock and L. S. Products	$ 8,052
Irrigated Crops	.....
Dryland Crops	.....
Mining	1,263
Meat Products	1,047
Dairy Products	1,143
Grain Products	782
Other Foods	1,886
Farm Machinery	142
Other Machinery	83
Metals	216
Agricultural Chemicals	1,222
Other Chemicals	94
Other Manufacturing	921
Trade	16,034
Finance	3,526
Insurance	1,512
Real Estate and Rentals	34,013
Transportation	2,761
Utilities	6,052
Services	11,208
Construction	.....
Households	63,769
TOTAL	$156,959

Source: The sector impacts were computed as the difference between the induced-by impact of the increase in output of Irrigated Crops and the induced-by impact of the associated decrease in output of Dryland Crops. The components of the output multipliers referred to in Chapter IV were used in the computations. Since the total induced-by impact was computed separately and not as the sum of the sector impacts, the total given here differs slightly from the sum of the column of sector impacts.

The summary discussion has thus far centered upon the current economic effects of irrigation during the production year 1963. The current impacts for the postwar period as estimated in this study are shown in Table 5.10. These include the direct and induced-by effects for the whole period and the stemming-from effects for the 1960's. Data limitations did not permit estimates of the latter for the whole postwar period. The current direct and induced-by impacts are also shown in Chart 5.3.

The lower frame of Chart 5.3 also indicates the increase in the number of irrigated acres from 1946 to 1966. Less than one million acres were irrigated in 1946. In contrast to 1946, over three million acres were irrigated in 1966. Chart 5.3 and Table 5.10 both indicate the substantial growth in the direct and induced-by impacts which has accompanied the increase in irrigation. This growth in impacts has been quite smooth except for a peak in 1956 and a low in 1962. These irregularities may be explained by referring back to Table 5.1. Examination of Table 5.1 indicates that in 1956 the dryland equivalent[15] on the irrigated acres was very

[15] The dryland equivalents refer to what could have been grown on the irrigated land under dryland conditions.

TABLE 5.10

Current Direct, Induced-by, and Stemming-from Effects of Irrigated Crops in Nebraska, 1946-65

Year (1)	Direct Effect (2)	Induced-by Effect (3)	Direct and Induced-by Effect (4)	Stemming-from Effect (5)
	(thousands of dollars)			
1946	$ 42,080	$ 50,597	$ 92,677	
1947	45,783	56,942	102,725	
1948	34,706	44,787	79,493	
1949	34,195	43,968	78,163	
1950	39,017	50,870	89,887	
1951	40,731	52,749	93,480	
1952	52,600	66,095	118,695	
1953	60,012	72,953	132,965	
1954	63,161	77,507	140,668	
1955	82,496	97,493	179,989	
1956	116,459	135,701	252,160	
1957	88,281	114,800	203,081	
1958	80,254	108,323	188,577	
1959	93,389	122,870	216,259	
1960	101,827	131,665	233,492	$446,778
1961	103,290	133,727	237,017	453,218
1962	84,951	116,793	201,744	372,755
1963	121,643	156,959	278,602	533,734
1964	132,296	168,647	300,943	580,507
1965	124,529	163,810	288,339	546,414

Source: Column 2 was obtained from Table 5.1. Column 3 was obtained from Table 5.3. Column 4 is the sum of Columns 2 and 3. Column 5 was obtained from Table 5.8.

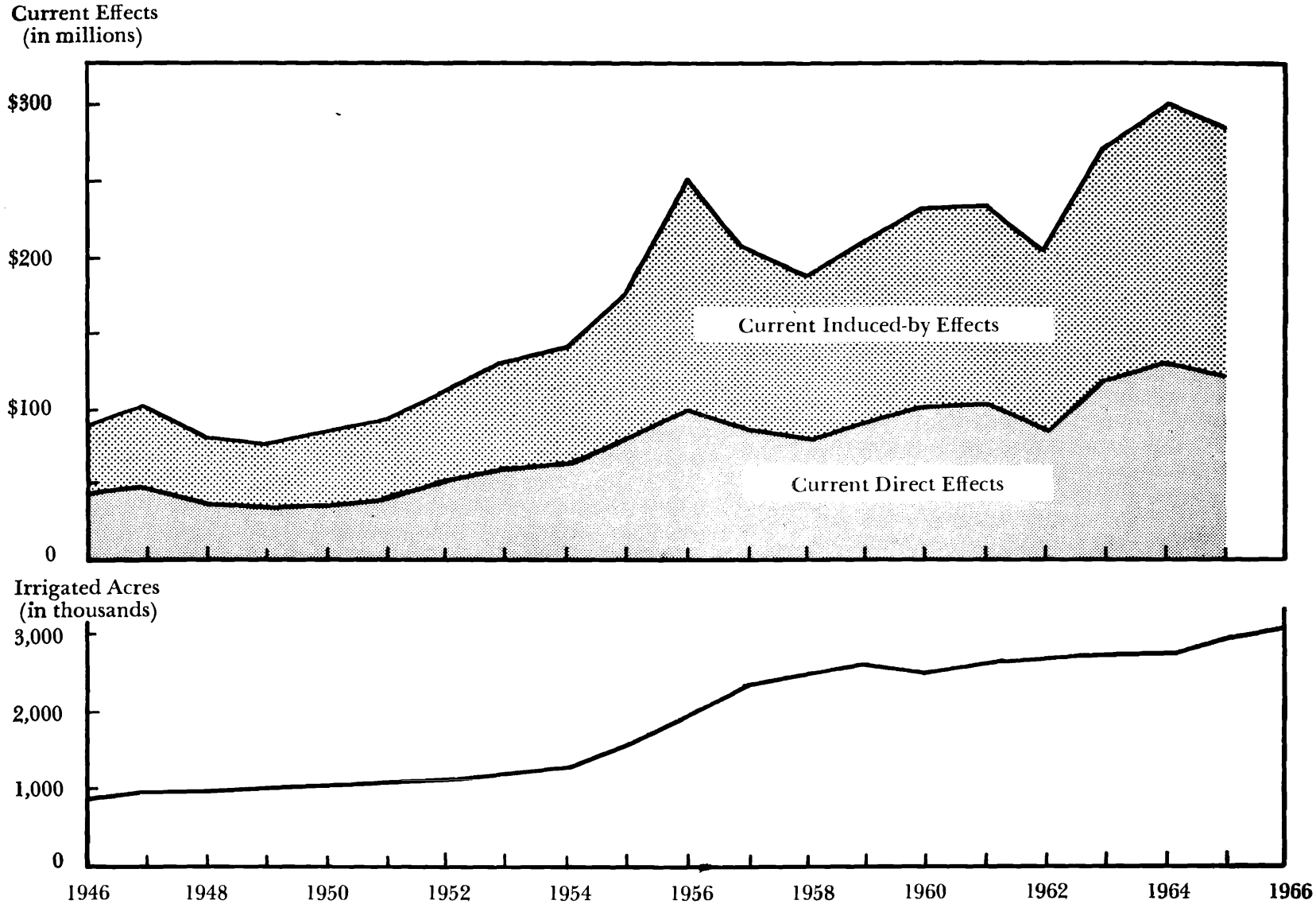
low and the corresponding 1962 figure was quite large. This is probably due in large part to the low average precipitation in 1956 and the high precipitation for 1962.[16] Thus the large direct impact in 1956 resulted from irrigation's large advantage in a relatively dry year and the lesser direct effect in 1962 resulted from irrigation's lesser advantage in a year of relatively large rainfall.

Column 4 of Table 5.10 gives the sum of the current direct and induced-by effects. This total is also indicated by the top line of Chart 5.3. These two types of impacts are additive because both represent transactions which are required to support the net increase in output of irrigated crops. The current stemming-from effects have not been combined with the direct and induced-by effects because they are not required to support the net increases in output of Irrigated Crops in the way the direct and induced-by effects are required. The stemming-from effects are estimates of the activities involved in processing the net increases in crop output. They can be described as *associated with* the net increases. While the stemming-from effects are not *required* as are the induced-by effects, they are exceedingly important for the economy of the state, as indicated by their size. For the years for which estimates were obtained, the current stem-

[16] Nebraska Department of Agriculture, *Nebraska Agricultural Statistics, Centennial Edition*, 1967, p. 80.

CHART 5.3

Current Direct and Induced-by Effects of Irrigated Agriculture upon the Nebraska Economy During the Postwar Period



Source: State-Federal Division of Agricultural Statistics, *Nebraska Agricultural Statistics, Annual Reports,* 1946-1966, and Tables 5.1 and 5.3.

ming-from effects were substantially greater than the total of the other current impacts—about 1.9 times as large.

It may be helpful to reduce these impacts to ratios which show the current impact per dollar of net increase in the output of Irrigated Crops. Such ratios are presented in Table 5.11 for the postwar period. The ratios showing the current direct and induced-by effects have shown a slight growth during the postwar period as the state's economy has supplied more of its own inputs. The ratios showing the current stemming-from effects are constant because the input-output relations for the year 1963 were assumed to apply to the period of the 1960's.

These last tables and Chart 5.3 point up the great and increasing importance of irrigation to the state's economy. The preceding analysis has also shown that the economic activity supporting irrigated crop production and involved in crop processing affects all industrial sectors of the economy and some of these to a very substantial degree.

TABLE 5.11

The Direct and Induced-by Effect and the Stemming-from Effect per Dollar of Net Increase in Output of Irrigated Crops in Nebraska, 1946-65

Year	Direct and Induced-by Effect	Stemming-from Effect
1946	$2.202	
1947	2.244	
1948	2,290	
1949	2.286	
1950	2.304	
1951	2.295	
1952	2.257	
1953	2.216	
1954	2.227	
1955	2.182	
1956	2.165	
1957	2.300	
1958	2.350	
1959	2.316	
1960	2.293	$4.388
1961	2.295	4.388
1962	2.375	4.388
1963	2.290	4.388
1964	2.275	4.388
1965	2.315	4.388

Source: Computed from Table 5.10.

APPENDICES

APPENDIX A

THE ECONOMIC EFFECT OF A HYPOTHETICAL TRANSFER OF LAND FROM DRYLAND TO IRRIGATED CROP PRODUCTION

INTRODUCTION

In Chapter V attention was focused upon a measurement of the economic impact of increased crop output from irrigated agriculture. The chapter opened with a general discussion of the types of economic effects associated with irrigation. To be more specific, economic impact was delineated into two major types: (1) current effect, and (2) investment effect. With the use of the 1963 Nebraska Input-Output Model the current effect of irrigation was measured.

The chapter closed with some general comments on the investment effect associated with irrigation. No attempt, however, was made in Chapter V to measure the impact of investments. To adequately measure *total* investment effect, a dynamic model is required. The Nebraska Input-Output Model is a static model since it relates to a cross-sectional analysis of the Nebraska economy for 1963. It is possible, however, to use this model to measure the impact of direct investments in irrigation.

The specific objectives of Appendix A are twofold. The first objective is an attempt to measure the effect of direct investments in irrigation on the Nebraska economy. This is accomplished by simulating a transfer of 10,000 acres of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector. The indirect investment effect will not be measured since this requires the construction of a dynamic model. Secondly, the current impact (both direct and indirect) of the transfer of tillable land is estimated. The major emphasis in this Appendix, in contrast to Chapter V, is the measurement of economic impact associated with the transfer of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector. The conditions which are assumed to apply to this hypothetical transfer greatly influence the resulting impact, as would be expected.

LAND TRANSFER AND INVESTMENT IMPACT

Before discussing the measurement of the economic impact of investments associated with a land shift, it may be useful to review briefly the types of economic impact associated with the growth of the Irrigated Crops Sector. For purposes of this study economic impact was broken-down into two major types: (1) investment effects and (2) current effects. In addition, both major types were delineated into direct and indirect effects, i.e., direct investment effect, indirect investment effect, direct current effect, and indirect current effect. For an extensive treatment of current effects it is suggested that the reader reread the section entitled "The Types of Impact" in Chapter V. The distinction between direct versus indirect investment effects is explained below.

Investment Effects Defined

Direct Investment Effects—Certain costs are associated with the transfer of land from the Dryland Crops Sector to the Irrigated Crops Sector. These direct investments may include the construction of reservoirs, the construction of distribution systems, the drilling of irrigation wells, and so on. All necessary additions to capital equipment on the farm are included. These investments, as any capital investment, will generate additional output and income in the internal economy. This impact on the economy has been defined in this study as the direct investment effect. A measure of direct investment effect is the incremental increase in gross outputs of the sectors of the economy.

Indirect Investment Effect—The impact of direct investments in irrigation can bring about: (1) the need to expand the facilities of those sectors that supply the materials and services used in irrigation investments and crop production, and (2) the need to expand facilities of those sectors that process crop output. No attempt is made in this study to measure the indirect investment effects associated with irrigation for reasons already outlined in the introduction and at the close of Chapter V.

Direct Investment and Economic Effects

To estimate the impact of direct investments, 10,000 acres of tillable land were hypothetically transferred from the Dryland Crops Sector to the

Irrigated Crops Sector. As already noted, certain direct investments are associated with this land shift. It should be noted, however, that investment costs will vary depending on the type and location of the irrigation system under consideration. Furthermore, the form of investment will vary between the surface type irrigation system and the well system. While the surface system requires investments in the construction of a reservoir and canals, the well system requires investments in the drilling of wells and irrigation pumps.

A weighted average of the direct investment costs per acre was computed by weighting the relative importance of the two systems in Nebraska. The relative importance of the two systems was determined by the porportion of land that was irrigated by each system in Nebraska for 1963. The investment costs were also based on 1963 prices. Thus the estimated costs do not reflect costs per acre for any one type of irrigation system, but are merely representative of the average cost of constructing an irrigation system in Nebraska for 1963.

In addition to the actual cost of constructing an irrigation system, additional farm equipment was assumed to be required because of (a) higher yields from irrigation, and (b) different cropping patterns for Irrigated Crops as contrasted with Dryland Crops. Estimates of increased expenditures for farm equipment, based on 1963 prices, were computed on a per acre basis. Table A.1 shows construction and equipment costs associated with the hypothetical movement of 10,000 acres of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector.

Table A.1 can be associated with the 1963 Nebraska Transactions Table as follows: The Construction and Farm Machinery Sectors refer to the same two sectors that appear in the 1963 Nebraska Transactions Table (Table C.1). Since $2,709 million of new construction costs are associated with the hypothetical land shift of 10,000 acres, the Nebraska Construction Sector is selling an additional $2.709 million to Final Demand. In addition, the level of sales by the Farm Machinery Sector to Final Demand has increased from $25.774 million to $26.238 million. The increase of $464,000 includes the purchase of (a) irrigation pumps and motors, (b) irrigation distribution systems and (c) new farm machinery. It should be noted that the total of new investments in equipment associated with the land shift is $957,000. In other words, $493,000 of new equipment was produced outside of Nebraska. Thus, the direct investments associated with the land shift brought about an increase in sales to Final Demand for two of the twenty-three endogenous producing sectors. The level of sales to Final Demand for the other producing sectors remained constant.

Since the final demand multipliers, which are discussed in Chapter IV, measure the economic impact associated with a change in sales to Final Demand, the economic impact associated with the direct investments in irrigation can be measured. By applying these multipliers to the change in sales to Final Demand, as shown in column 2 of Table

TABLE A.1

Construction and Equipment Costs Associated with a Simulated Movement of 10,000 Acres Under Irrigation

Sector (1)	Total Cost (2)	Purchased in Nebraska (3)	Imported (4)
	(thousands of dollars)		
Construction	2,709	2,709	.....
Farm Machinery and Equipment	957	464	493

Source: Interviews with Nebraska manufactures of irrigation equipment and the Department of Agricultural Engineering, University of Nebraska, Lincoln, Nebraska.

TABLE A.2

The Economic Impact of the Direct Investments Associated with the Transfer of 10,000 Acres from Dryland Crops to the Irrigated Crops Sector—1963 prices

Sectors (1)	Direct Investments (Change in Final Demand) (2)	Economic Impact of Direct Investments (Expressed as change in Gross Output) (3)
	(thousands of dollars)	
Livestock and L. S. Products	.....	65.73
Irrigated Crops	.....	10.31
Dryland Crops	.....	9.61
Mining	.....	81.83
Meat Products	.....	33.01
Dairy Products	.....	36.20
Grain Products	.....	7.60
Other Foods	.....	59.81
Farm Machinery	464	464.41
Other Machinery	.....	9.68
Metals	.....	72.28
Agri. Chemicals	.....	0.14
Other Chemicals	.....	5.23
Other Mfg.	.....	30.33
Trade	.....	559.82
Finance	.....	34.67
Insurance	.....	37.18
Real Estate and Rentals	.....	306.89
Transportation	.....	110.62
Utilities	.....	126.59
Services	.....	328.98
Construction	2,709	2,709.00
Households	.....	2,023.56
TOTAL		7,123.48

Source: These measures of direct investment impact were found by multiplying the 1963 Nebraska Total Requirements Table (Table C.3) times the change in sales to Final Demand associated with the land shift.

A.2, the economic impact of direct investments was measured. This is shown in column 3 of Table A.2 for each of the endogenous sectors.

The largest impact, as indicated in Table A.2, occurs in the Construction Sector. The increase in gross output is obviously due to the Construction Sector's increase in sales to Final Demand. The gross output for the Farm Machinery Sector increased by $464,410. Again, this is largely due to the increase in sales to Final Demand by the Farm Machinery Sector. Notice, however, that the increase in gross output of $464,410 exceeds the original increase in sales to Final Demand by $410. The $410 illustrates the increase in the internal demand for inputs from the Farm Machinery Sector which are necessary to enable this sector to increase its sales to Final Demand by $464,000. The internal demand generated by the direct investments in irrigation is even more apparent for such sectors as Trade and Real Estate. Even though sales to Final Demand increased in only two sectors (due to direct investments in irrigation), internal demand, as indicated by the increase in gross output, increased for all the endogenous producing sectors (Table A.2).

The impact of direct investments in irrigation can best be grasped by viewing the total change in transactions (gross output) for Nebraska. The direct investments necessary to transfer 10,000 acres from Dryland Crops to Irrigated Crops brought about an increase in transactions of $7,123,480. Included in this sum is an increase in personal income of $2,023,560. This is shown in Table A.2 as payments to Households.

It may be desirable to express the direct investment effects on a per acre basis. For instance, approximatley $712 of transactions are generated in the Nebraska economy by the direct investments involved in converting one acre of dryland production to irrigated production. The reader should note that the above estimates assume (a) 1963 prices and (b) the 1963 Nebraska interindustry relationships. In addition, these estimates are based on a weighted average of the kinds of direct investments made in irrigation in Nebraska.

LAND TRANSFER AND CURRENT ECONOMIC EFFECT

Chapter V was concerned with the measurement of the curent economic effects associated with irrigation. This problem was approached by first estimating the net increase in crop output due to irrigation which actually occurred.

In this simulation approach the comparable objective is to estimate the net change in crop production associated with the hypothetical transfer of 10,000 acres of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector.[2] Obviously, as land is shifted from dryland farming to irrigated farming, the output of the Dryland Crops Sector will decline whereas the output of the Irrigated Crops Sector will increase. The net effect should be an increase in total crop production since higher production yields accompany irrigation. As was pointed out in Chapter V, certain changes in internal demand accompany the net increase in crop production. This has been defined as the current economic impact of irrigation.

The 1963 Nebraska Input-Output Model was used as the basis for estimating the current economic effects associated with the hypothetical land shift. Certain necessary adjustments, however, were incorporated into the model to reflect the transfer of 10,000 acres of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector. In particular, the direct requirement *rows* for the Dryland and Irrigated Crops Sectors (Table C.2) were adjusted. The adjustments reflect certain changes in the level and pattern of sales for the Dryland and Irrigated Crops Sectors, respectively. Obviously, the level of sales for each crop sector will change when land is transferred. To make the simulated changes in the level of sales and pattern of sales for the Dryland and Irrigated Crops Sectors, the following assumptions were made: (1) The percentage distribution of sales by Dryland Crops to the endogenous sectors would not change; and (2) the endogenous sectors which purchase Nebraska crops would substitute irrigated crop output for dryland crop output as land is moved from the Dryland Crops Sector to the Irrigated Crops Sector. Given these assumptions, the percentage distribution of sales by Irrigated Crops will change because of the substitution of irrigated crop output for dryland crop output. After this substitution, the total crop input (produced in Nebraska) per dollar of output for any endogenous sector remains constant. In other words, for any column j, the sum of the "adjusted" direct requirement coefficients from the Dryland and Irrigated Crops Sectors should equal the sum of the same pair of original coefficients. An illustration of this point will be given later.

When 10,000 acres of tillable land were hypothetically shifted to the Irrigated Crops Sector, it was assumed that dryland production would decrease by approximately $331,000. In contrast, it

[2] This approach permits one to sketch out the negative and positive generating effects of a land transfer which accompanies the growth of the Irrigated Crops Sector.

was assumed that irrigated output would increase by approximately $885,000. Thus the net change in crop output was estimated to be an increase of $554,000. This is shown in Table A.3 and represents an average of 1962, 1963, and 1964 farm prices, patterns of production, and yields.

It should be noted that the assumptions underlying these changes in output represent different productivities from those used in Chapter V in computing the net increase in output of Irrigated Crops. In this hypothetical transfer, statewide averages for irrigated land and dryland were used. In Chapter V the actual reported production on irrigated land was used in estimating the output of Irrigated Crops. However, the dryland equivalents were not based on state averages but on the productivities of comparable dryland in counties in which the irrigation occurred. Because of these differences, the current effects noted here will not be the same as those reported in Chapter V. The purpose here with respect to the current effects is not to verify the analysis of Chapter V but to illustrate the simulation approach.

After estimating the net change in crop output, the direct requirements rows for the Dryland and Irrigated Crops Sectors of the Direct Requirements Table were adjusted. Assumptions 1 and 2 were followed in making these adjustments. Table A.4 shows the "adjusted" direct requirement coefficients for the Dryland Crops Sector and the Irrigated Crops Sector. As already noted, for any column sector *j*, the sum of the adjusted direct requirement coefficients from Dryland and Irrigated Crops should equal the sum of the same pair of original coefficients. As an illustration, for each dollar of output the Grain Products Sector purchased about 49 cents of Nebraska crop production in 1963 (Table C.2). After the land transfer, the Grain Products Sector still purchases about 49 cents of crop production from Nebraska (Table A.4). It is important to note that the rows in Table A.4 correspond to columns in the Nebraska Direct Requirements Table (Table C.2).

TABLE A.3
Output Adjustments for Dryland and Irrigated Crops Resulting from a Hypothetical Shift of 10,000 Additional Acres Under Irrigation

Sector (1)	1963 Value of Output (2)	Adjustment for Land Shift (3)	Estimated Output after Land Shift (4)
	(thousands of dollars)		
Dryland Crops	$512,593	-$331	$512,262
Irrigated Crops	185,004	885	185,889

Source: These estimates are based on the average cropping pattern and value of total output for Dryland and Irrigated Crops as given in the *Nebraska Agricultural Statistics* for the years 1962, 1963, and 1964.

TABLE A.4
Adjusted Direct Requiremnets for the Dryland and Irrigated Crops Rows of the Direct Requirements Table

Sectors (1)	Adjusted Direct Requirements Coeff. for Irrigation (2)	Adjusted Direct Requirements Coeff. for Dryland (3)
Livestock and L. S. Products	0.06156	0.08066
Irrigated Crops	0.01474	0.00250
Dryland Crops	0.00383	0.01493
Mining	0.00000	0.00000
Meat Products	0.00000	0.00000
Dairy Products	0.00000	0.00000
Grain Products	0.15207	0.33984
Other Foods	0.07350	0.00308
Farm Machinery	0.00000	0.00000
Other Machinery	0.00000	0.00000
Metals	0.00000	0.00000
Agri. Chemicals	0.00000	0.00000
Other Chemicals	0.00000	0.00000
Other Mfg.	0.00000	0.00000
Trade	0.00000	0.00000
Finance	0.00000	0.00000
Insurance	0.00000	0.00000
Real Estate and Rentals	0.00000	0.00000
Transportation	0.00050	0.00000
Utilities	0.00000	0.00000
Services	0.00004	0.00000
Construction	0.00000	0.00000
Households	0.00023	0.00065

Source: These input coefficients were computed after adjusting the sales Transactions Table. The Transacttions Table was adjusted on the basis of the assumptions outlined earlier in this appendix. The adjusted Transactions Table is not shown here. It should be kept in mind that the direct requirement coefficients shown in this table are the adjusted Irrigated and Dryland Crops *rows* of the Direct Requirements Table.

After the Direct Requirements Table was adjusted, the next step was to compute the Total Requirements Table. This table is not shown here, but it is similar to the Total Requirements Table shown in Table C.3. If the reader will recall from Chapters IV and V, the Total Requirements Table is necessary to measure economic impact.

The various types of curent economic effects associated with the hypothetical land transfer will be discussed in the following order: (a) current direct economic effects, (b) current induced-by effects, and (c) current stemming-from effects.[3]

First, the current direct economic effect has been defined in this study as a *net difference* between irrigated crop output and dryland crop output equivalents. Thus, due to the hypothetical transfer of 10,000 acres of tillable land to the Irrigated Crops Sector, the estimated net increase in crop output was $554,000. This is the *current direct effect* of irrigation and is found by summing the values in column 3 of Table A.3. Obviously, a

[3] The reader is referred to Chapter V for a complete definition and an illustration of the different types of current economic effects.

negative current direct effect occurred in the Dryland Crops Sector since crop output declined for this sector.

The current induced-by effects of the land transfer were estimated by first multiplying the change in crop output of each crop sector by that sector's output multiplier and its cell components.[4] This made it possible to estimate the current induced-by effects upon *each* of the Nebraska supporting sectors. The estimates for the Dryland Crops Sector (column 2) and the Irrigated Crops Sector (column 3) are shown in Table A.5. If the reader will recall, the current economic effects of irrigation have been defined as the economic effects associated with a *net* increase in crop output which is due to irrigation. Thus it was necessary to subtract column 2 from column 3 to estimate the current induced-by effects of irrigation (land transfer). The *current induced-by effects* of irrigation are shown in column 4 of Table A.5.

The next step was to examine the current stemming-from effects of irrigation which are due to the hypothetical land shift. In order to measure the current stemming-from effects of irrigation, an increase in the level of crop processing in Nebraska was simulated. In short, this implies that an increase in the activity of the crop processing sectors stems from the net increase in crop production. It was assumed that the flow of crop inputs to the Grain Products Sector would increase in proportion to the increases in crop production.

It must be acknowledged at the outset that the implication of causality is open to criticism. That is, it is a question whether or not an increase in the level of crop production causes an increase in the output of, say, the Grain Products Sector or even the Livestock and Livestock Products Sector in Nebraska. It may be argued that a certain relationship does in fact exist. The purpose of this section is not to argue the existence or the degree of causality, but to show the current stemming-from effects which can result from a land shift.

If some of the increased crop production is "passed-through" the crop processing sectors, the volume of sales to Final Demand will increase. But precisely how much does the level of sales to Final Demand increase? To answer this question the 1963 interindustry trade relationships in Nebraska (adjusted for the land shift) were used. For instance, after adjusting the Total Requirements

TABLE A.5

Current Induced-by Effects Associated with the Transfer of 10,000 Acres from the Dryland Crops Sector to the Irrigated Crops Sector

Sector (1)	Current Induced-by Effects of a Decrease in Dryland Output (2)	Current Induced-by Effects of an Increase in Irrigated Output (3)	Total Current Induced-by Effects (4)
	(thousands of dollars)		
Livestock and L. S. Products	$ -9.69	$ 46.52	$ 36.83
Irrigated Crops	.....	.....	.....
Dryland Crops	.....	.....	.....
Mining	-1.46	7.24	5.78
Meat Products	-2.05	6.83	4.78
Dairy Products	-2.24	7.46	5.22
Grain Products	-0.99	4.57	3.58
Other Foods	-3.71	12.32	8.61
Farm Machinery	-0.04	0.69	0.65
Other Machinery	-0.14	0.52	0.38
Metals	-0.21	1.20	0.99
Agri. Chemicals	-1.88	7.45	5.57
Other Chemicals	-0.16	0.59	0.43
Other Mfg.	-2.07	6.27	4.20
Trade	-35.18	108.31	73.13
Finance	-17.78	33.74	15.96
Insurance	-4.13	11.01	6.88
Real Estate and Rentals	-48.68	204.13	155.45
Transportation	-6.41	19.00	12.59
Utilities	-11.12	38.75	27.63
Services	-26.85	77.94	51.09
Construction	.....	.....	.....
Households	-124.45	415.46	291.01
TOTAL	-299.24	1,010.00	710.76

Source: Tables A.3 and A.4.

Table for the land shift, it was found that 6.2 per cent of Irrigated Crops' output was associated with Other Foods' sales to Final Demand.[5] In other words, approximately 6 cents of a dollar's worth of Irrigated Crops' output was used by Other Foods and their suppliers to support a dollar of sales to Final Demand. Multiplying the 6.1635 per cent by the "residual"[6] of the increase in crop production for Irrigated Crops shows the amount available to sup-

[4] The method for computing output multipliers is discussed in Chapter IV. The output multipliers for the Crops Sectors used here were computed from the "adjusted" Total Requirements Table. Thus they differ slightly from the output multipliers shown in Chapter V.

[5] The 6.2 percent was derived in the following way. Multiplying Other Foods' total volume of sales to Final Demand times the final demand multiplier for Other Foods gives the value of irrigated crop production necesary to support this transaction to Final Demand. The next step was to express this figure as a percent of the *total* irrigated crop output (6.1935 percent).

[6] The term "residual" requires some explanation. Table A.3 shows that irrigated crop output, as a result of the hypothetical land shift, increased by $885,000. Some of this increase is used internally since the total level of dryland crop production decreased as a result of the land shift. (This statement is in reference to assumptions 1 and 2 which are stated in an earlier section of this appendix). Subtracting the increase in the internal demand for irrigated crop output from the increase in irrigated crop output, associated with the land shift, leaves a residual. The residual was used for estimating the current stemming-from effects that can occur as a result of a land shift.

port an increase in sales to Final Demand by Other Foods. Thus approximately $48,000 of the residual in crop production can be assumed to be associated with the increase in sales to Final Demand by the Other Foods Sector. To compute the net increase in sales to Final Demand for Other Foods, the same method is used here as in Chapter V. For instance, 0.08997 of a dollar of crop production is required to support a dollars worth of sales to Final Demand by Other Foods. Thus the $48,000 of additional crop production going to Other Foods could support an additional $533,000 of sales to Final Demand. This procedure was followed for other crop processing sectors studied here, namely, Livestock and Livestock Products, Meat Products, and the Grain Products Sectors.[7]

It should be noted that for the Meat Products Sector there is in effect a two-stage crop processing chain. To illustrate, a portion of crop production is sold to the Livestock and Livestock Products Sector. This sector in turn sells a portion of its output to the Meat Products Sector which in turn sells processed meat to Final Demand. If increased crop production results in an increase in the level of output for the Livestock and Livestock Products Sector, then one might expect an increase in the level of output of the Meat Products Sector. Furthermore, the level of sales to Final Demand by the Meat Products Sector should increase. In short, an increase in crop production may bring about an increase in sales to Final Demand by the Meat Products Sector via a two-stage crop processing chain. Three-stage crop processing chains also exist; for instance the Irrigated Crops to Grain Products to Livestock and Livestock Products to Meat Products to Final Demand processing chain. A three-step crop processing chain was not examined in this study because of the illusiveness of the "stemming-from" relationship. In contrast, sales to Final Demand via Livestock and Livestock Products, Grain Products, and Other Foods are one-stage crop processing chains.

Table A.6 shows the current stemming-from effects for major crop processing sectors (measured in gross output) that can occur when 10,000 acres of tillable land are transferred from the Dryland Crops Sector to the Irrigated Crops Sector. This table implies that a net increase in crop production which accompanies a land shift sets in motion an increase in the level of production of the crop processing sectors for Nebraska. Column 3 of Table A.6 shows the current stemming from effects associated with the one-stage crop processing sectors. In contrast, column 5 shows the current stemming-from effects associated with a single two-stage crop processing chain.

TABLE A.6

Stemming-from Effects Associated with the Transfer of 10,000 Acres from the Dryland to the Irrigated Crops Sector; Nebraska 1963

Sectors (1)	One-Stage Processing Sectors[a]		Two-Stage Processing Sector[b]	
	Increase in Sales to Final Demand (2)	Increase in Gross Output (3)	Increase in Sales to Final Demand (4)	Increase in Gross Output (5)
	(thousands of dollars)			
Livestock and L. S. Products	$ 76	$ 109	.....	$1,075
Irrigated Crops	.....	.....	.....	.....
Dryland Crops	.....	.....	.....	.....
Mining	.....	1	.....	2
Meat Products	.....	7	$1,395	1,469
Dairy Products	.....	8	.....	13
Grain Products	196	215	.....	97
Other Foods	533	541	.....	20
Farm Machinery	.....	.....	.....	.....
Other Machinery	.....	2	.....	1
Metals	.....	9	.....	8
Agri. Chemicals	.....	.....	.....	.....
Other Chemicals	.....	4	.....	2
Other Mfg.	.....	12	.....	11
Trade	.....	73	.....	173
Finance	.....	11	.....	57
Insurance	.....	5	.....	16
Real Estate and Rentals	.....	33	.....	112
Transportation	.....	35	.....	95
Utilities	.....	22	.....	63
Services	.....	49	.....	97
Construction	.....	0	.....	0
Households	.....	239	.....	664
TOTAL		1,375		3,975

[a] This includes the following one-stage crop processing sectors: (1) Livestock and Livestock Products, (2) Grain Products, and (3) Other Foods.
[b] These estimates refer to the Irrigated Crops-Livestock and Livestock Products-Meat Products two-stage processing chain.
Source: Computed as described in the accompanying text.

An additional comment should be appended to the discussion of current stemming-from effects. The generating power of a dollar's worth of crop output to Final Demand via the two-stage crop processing chain is greater than for a one-stage crop processing chain. Obviously, this should be expected since more internal activity is associated with a two-stage processing chain than a one-stage processing chain.

SUMMARY

The problem of estimating the investment impact of irrigation was approached by simulating with the input-output model for 1963 a hypo-

[7] The "adjusted" Direct Requirements Table was used here to estimate the change in the level of sales to Final Demand by the crop processing sectors.

thetical transfer of 10,000 acres of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector. Because of data and model limitations only the direct investment effect was estimated. The resulting estimates of the direct investment impact were based on average investment costs for the period 1962-64. By assuming other cost patterns, different investment impacts would be obtained.

It may be of interest to review the direct investment impact on a per acre basis. This can be readily accomplished by dividing the appropriate figures from Tables A.1 and A.2 by 10,000 acres. Thus it was estimated that approximately $317 of direct investments in construction and capital equipment (purchases from Nebraska firms) are required to shift one acre of tillable land from the Dryland Crops Sector to the Irrigated Crops Sector. In addition some $49 per acre of equipment was imported into the state on the average to support the land transfer. The $317 of capital exependitures per acre within the state generated total transactions within the state estimated at $712 per acre. This of course assumes the spending patterns implicit to the input-output model of 1963.

It has also been demonstrated that the simulation technique may be used to estimate the current impacts of a land transfer under assumed conditions. The results are presented in Tables A.5 and A.6, and may also be converted to a per acre basis with appropriate adjustments. Because of different starting assumptions these results do not equal the results obtained in Chapter V. They do illustrate that the simulation technique enables one to examine certain impacts on the basis of a variety of possible assumptions with respect to the productivity of dryland and irrigated land and with respect to the disposition of output.

The simulation technique allows one to make a *hypothetical* change in the number of acres under irrigation. Then one can simulate certain adjustments in the economic structure resulting from the change in the number of acres under irrigation. The advantage of this technique is that it allows one to trace the effects of simulated changes before these changes and the resulting adjustments to them actually occurs.

APPENDIX B

INDUSTRY DESCRIPTIONS, GROSS OUTPUT ESTIMATES, AND DATA SOURCES

TABLE B.1
INDUSTRY DESCRIPTIONS AND GROSS OUTPUT

Input-Output Code Number	Industry Name	SIC Code Number	Descriptions	Estimated Gross Output ($1,000)
1	Livestock & Livestock Products	013, part of 014	Meat animals, poultry, and poultry products, milk and butterfat, wool production, & other livestock products	845,201
2	Irrigated Crops	01, except 013 & part of 014	Cash grains, field crops, fruits & vegetables, commercial seed, & custom work	185,004
3	Dryland Crops			512,593
4	Mining	10–14	Extraction of minerals, quarrying, well operation, milling, etc.	96,816
5	Meat Products	201	Meat packing plants, prepared meat products, poultry & small game dressing & packing	913,325
6	Dairy Products	202	Manufacture of creamery butter, cheese, condensed & evaporated milk, ice cream, frozen desserts; processing of fluid milk & cream	115,400
7	Grain Products	204	Flour & other grain mill products, prepared feeds, cereal preparations, rice milling, blended & prepared flour, & wet corn milling	232,265
8	All other Food & Kindred Products	20, except 201, 202, & 204	Canned & pkg. foods, bakeries, candy, bottled soft drinks, fats and oils, noodles, ice, & other food preparations not elsewhere classified	244,759
9	Farm Machinery & Equipment	352	Farm, ranch, haying & irrigation equipment & systems	26,813
10	Other Machinery & Equipment	35 & 36, except 352	All machines & electrical equipment & supplies except farm machinery & equipment	150,504
11	Metals	33 & 34	Primary metal industries & fabricated metal products except ordnance, machinery, & transportation equipment	251,188
12	Agricultural Chemicals	287	Fertilizer & agricultural pesticides & chemicals	15,517
13	Other Chemicals	28, except 287	Plastics & synthetic resins, pharmaceutical preparations, soap, & other cleansers, paints, perfumes, glues & other chemical preparations	67,950
14	Other Manufacturing	19–39, except 20, 28, 33–36	Textiles, apparel, wood products, leather goods, paper products, transportation equipment, rubber products, printing & publishing, & other miscellaneous manufacturing (newspaper advertising is included in Services)	406,500
15	Trade	50, 52–59	Wholesale & retail	867,602
16	Finance	60 except 605; 61 except 615, 616; 62 except 628	Banking, credit agencies other than banks, security brokers & salesmen	163,206
17	Insurance	63, 64	Domestic life & nonlife companies; agents of non-domestic companies	336,228
18	Real Estate and Rentals	65 except 656	Real estate agents & brokers; all contract rents; imputed rent of owner-occupied farm & nonfarm homes	594,964
19	Transportation & Warehousing	40, 41, 42 except 422; 445, 451, 46	Railroads; railway express services; freight, water, air, pipeline, & passenger transportation	297,167
20	Utilities	48, 49, except part of 4953	Electric, gas, water & sanitation companies; telephone & telegraph companies; radio & TV broadcasting	257,156
21	Services	0722, 70–82 except 71, 77; 866, 867, 869, 89	Lodging places; personal, professional, business, repair, & amusement services; medical, educational, & nonprofit institutions	775,125
22	Construction	15, 16, 17, 656	Building & other construction by general contractors; special trade contractors	434,000
23	Households		Residents of Nebraska	3,419,000

TABLE B.2
DATA SOURCES FOR OUTPUT TOTALS

Sector	Data Sources
1. Livestock and Livestock Products	Nebraska Department of Agriculture and Inspection, *Nebraska Agricultural Statistics, Annual Report: 1962, 1963,* and *1964*
2. Irrigated Crops	
3. Dryland Crops	
4. Mining	U. S. Bureau of the Census, *Census of Mining: 1963*
5. Meat Products	
6. Dairy Products	
7. Grain Products	
8. Other Food Products	
9. Farm Machinery and Equipment	U. S. Bureau of the Census, *Census of Manufacturers, Nebraska: 1963,* and "Value of Shipments for the State of Nebraska" (unpublished)
10. Other Machinery and Equipment	
11. Metals	
12. Agricultural Chemicals	
13. Other Chemicals	
14. Other Manufacturing	
15. Trade	U. S. Bureau of the Census, *Census of Business, Retail Trade, Nebraska: 1963; Wholesale Trade, Nebraska: 1963;* Dun and Bradstreet, *Cost of Doing Business in 185 Lines-Corporations;* Robert Morris and Associates, *1962 Statement Studies*
16. Finance	Federal Deposit Insurance Corporation, *Annual Report: 1963;* Nebraska Department of Banking, *Report of the Department of Banking, June 29, 1963 to June 30, 1964;* U. S. Bureau of the Census, *Statistical Abstract of the United States: 1963* and *1964;* U. S. Department of Commerce and U. S. Department of Health, Education and Welfare, *County Business Patterns, First Quarter: 1964;* earnings/assets ratios; earnings/employee ratios
17. Insurance	Nebraska Department of Insurance, *Annual Report: 1963;* convention forms; survey data
18. Real Estate and Rentals	Studies of other sectors
19. Transportation and Warehousing	Nebraska Railway Commission, *Annual Report: 1963;* Interstate Commerce Commission, *Transport Statistics: 1963; Statistical Abstract: 1964; County Business Patterns: 1964;* annual reports of motor carriers; revenues/mileage-operated ratios; revenue/employee ratios
20. Utilities	Federal Power Commission, *Statistics of Electric Utilities in the United States: 1963, Publicy Owned;* Nebraska Railway Commission, *Annual Report: 1963;* U. S. Bureau of the Census, *Census of Governments: 1962; Statistical Abstract: 1965;* earnings/employee ratios
21. Services	Office of Business Economics, *The 1958 Interindustry Relations Study;* U. S. Department of Health, Education and Welfare, *Trends Part Two, 1964 edition,* and *1965 edition: Census of Selected Services, United States: 1963* and *Nebraska: 1963; County Business Patterns: 1964; Statistical Abstract: 1964, 1965, and 1966;* receipts/employee ratios; expenditure/pupil ratios; expenditure/employee ratios
22. Construction	*Statistical Abstract: 1964;* value-put-in place/contracts-awarded ratios
23. Households	U. S. Department of Commerce, *Survey of Current Business,* August 1966; unpublished data of the Office of Business Economics of the Department of Commerce on Nebraska personal income

TABLE B.3
DATA SOURCES FOR ALLOCATION

Industry	Data Sources
1. Livestock and Livestock Products 2. Irrigated Crops 3. Dryland Crops	University of Nebraska, College of Agriculture and Home Economics, *Nebraska Farm Management, Summary and Analysis Report: 1964* and *1965; Cost of Operating Tractors in Nebraska: 1961; Nebraska Livestock and Feed Roundup for 1963–64;* Nebraska Department of Agriculture and Inspection, *Nebraska Agricultural Statistics, Annual Report: 1962, 1963,* and *1964;* Iowa State University, Agriculture and Home Economics Experiment Station, *Transportation of Grain and Mixed Feeds from Iowa* (Special Report No. 50); Washington State University, Agricultural Experiment Station, *Shifts in the Production and Marketing of Stocker-Feeder Cattle* (Bulletin 667); U. S. Department of Agriculture, *Farm Income, State Estimates, 1949–1965;* U. S. Bureau of the Census, *Census of Agriculture: 1959* and *1964* preliminary; studies of other sectors
4. Mining	U. S. Bureau of the Census, *Census of Mining: 1963;* U. S. Bureau of Mines, *Minerals Yearbook: 1963;* National Sand and Gravel Association, *Production and Value of Sand and Gravel in 1965;* studies of other sectors
5. Meat Products 6. Dairy Products 7. Grain Products 8. Other Food Products 9. Farm Machinery and Equipment 10. Other Machinery and Equipment 11. Metals 12. Agricultural Chemicals 13. Other Chemicals 14. Other Manufacturing	Survey data; studies of other sectors
15. Trade	National I-O coefficients; studies of other sectors
16. Finance	Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin, February, 1964;* Federal Deposit Insurance Corporation, *Annual Report: 1963;* Federal Reserve Bank of Kansas City, *Operating Ratios of Member Banks, Tenth Federal Reserve District: 1963;* Nebraska Department of Banking, *Report of Department of Banking, 1963 to 1964;* national I-O coefficients; studies of other sectors
17. Insurance	Nebraska Department of Insurance, *Annual Report: 1963;* Nebraska State Tax Commissioner, *Annual Report: 1963;* U. S. Bureau of the Census, *Census of Manufacturers, Nebraska: 1963; Census of Agriculture, Nebraska: 1964-preliminary;* Nebraska Department of Agriculture and Inspection, *Nebraska Agricultural Statistics, Annual Report: 1963; County Business Patterns: 1964;* convention forms; survey data; studies of other sectors
18. Real Estate and Rentals	National I-O coefficients; studies of other sectors
19. Transportation and Warehousing	National sales patterns; national I-O coefficients; studies of other sectors; Nebraska Railway Commission, *Annual Report: 1963; Transport Statistics: 1963;* expense/mileage ratios; annual reports of motor carriers
20. Utilities	Nebraska Railway Commission, *Annual Report: 1963; Statistical Abstract: 1965; Statistics of Electric Utilities: 1963;* national sales patterns; national I-O coefficients; survey data
21. Services	*Nebraska State Auditor's Report: 1963; Annual Report of the Nebraska Department of Education: 1963;* national sales patterns; national I-O coefficients; studies of other sectors
22. Construction	National I-O Coefficients; studies of other sectors; expenses/receipts ratios
23. Households	Unpublished data of the Office of Business Economics of the Department of Commerce on Nebraska personal income; Department of Commerce, *Statistics of Income: Individual Income Tax Returns, 1963;* Bureau of Labor Statistics, *Consumer Expenditures and Income: Total North Central Region, Urban and Rural, 1960–61;* survey data; studies of other sectors

APPENDIX C

NEBRASKA INPUT-OUTPUT TABLES FOR 1963

TABLE C.1
TRANSACTIONS TABLE
NEBRASKA ECONOMY
1963

[All Figures in Thousands of Dollars at Producers' Prices]

			PURCHASING SECTORS																							FINAL DEMAND						
			AGRICULTURE			MINING AND MANUFACTURING											NONCOMMODITY															
			Livestock	Irrigation	Dryland	Mining	Meat Products	Dairy Products	Grain Products	Other Food	Farm Machinery	Other Machinery	Metals	Agri. Chemicals	Other Chemicals	Other Manufacturing	Trade	Finance	Insurance	Real Estate	Transportation	Utilities	Services	Construction	Households	State & Local Govt.	Federal Govt.	Gross Private Capital	Net Change in Inventories	Exports	TOTAL OUTPUT	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
SELLING SECTORS — AGRIC.	Livestock and Livestock Products	1	150,647	5,659	7,086		544,232	75,271		122											15		67		16,766					45,336	845,201	1
	Irrigated Crops	2	51,984	2,727	1,965				35,270	17,988											150		30		778					74,112	185,004	2
	Dryland Crops	3	69,069	462	7,655				78,984	756															2,156					353,511	512,593	3
MINING AND MANUFACTNRING	Mining	4	20	885	1,109	9,974			46	73			91	2,654	295	12,845				1,576	651	1,207	5	11,316		4,187	1,272			48,610	96,816	4
	Meat Products	5					37,711		3,000	83							514				348		1,621		49,891	178	26,402		3,570	790,007	913,325	5
	Dairy Products	6						2,938		1,657							346				261		2,117		55,252	313	5,220			47,296	115,400	6
	Grain Products	7	75,095						2,333	3,166				62			328				174		910		388	120				149,689	232,265	7
	All Other Food Products	8	50				27	668	110	414					409		1,224				88		3,566		93,795	30	7,057		297	137,024	244,759	8
	Farm Machinery and Equipment	9	5	128	22				263				34											5	582	55	407	2,919	739	21,654	26,813	9
	Other Machinery and Equipment	10					9	22	1,267	293	466	120	784	292		73					1,168	1,646			5	464	46,780	6,718	–15,091	105,488	150,504	10
	Metals	11		98			3,928		107	3,534	1,018	88	15,409			8,033				63	805	1,498		7,614		2,858	198	31,039	2,223	172,675	251,188	11
	Agricultural Chemicals	12	42	1,549	2,875																					23	5			11,023	15,517	12
	Other Chemicals	13				490	9	151	2,203	990	31	38	122	6	379	350	244			600	244	49	1,175	392	470	578	1,767		127	57,535	67,950	13
	Other Manufacturing	14	386	44	186	15	346	703	1,420	3,275	168	264	3,068	49	2,494	4,716	7,623	2,836	3,829	1,451	2,192	1,801	1,792	252	23,197	811	1,329	9,699	2,195	330,359	406,500	14
NON-COMMODITY	Trade	15	29,602	8,122	22,539	1,444	16,122	3,027	11,035	9,272	907	5,507	7,694	376	1,643	11,416	12,538	1,372	2,826	8,919	7,609	2,050	16,279	35,746	467,625	1,818	786	29,754		151,574	867,602	15
	Finance	16	34,281	4,951	23,258	846	1,224	17	1,429	604	276	69	479	16	457	386	2,556	4,154	551	11,517	1,039	886	2,430	791	16,473	2,537	34,200			17,779	163,206	16
	Insurance	17	1,887	591	2,672	205	144	43	64	102	19	94	86	20	89	267	2,591	102	434	3,488	6,566	611	3,124	222	44,918	129				267,760	336,228	17
	Real Estate and Rentals	18	19,582	29,267	45,416	7,429	585	386	456	470	108	1,048	144	6	71	1,451	40,092	1,954	4,578	12,173	7,771	3,670	34,778	1,736	379,000	906	1,887				594,964	18
	Transportation and Warehousing	19	16,483	2,307	6,401	2,526	35,062	436	15,199	6,666	178	3,230	3,683	2,183	1,197	4,398	3,609	1,449	1,292	3,315	18,933	3,377	4,125	12,920	5,000	363	26,651			116,184	297,167	19
	Utilities	20	8,858	2,798	5,335	982	8,722	865	3,133	2,148	212	1,286	3,622	1,566	809	5,561	22,341	942	585	3,545	3,316	8,106	27,524	1,794	121,000	2,317	9.748			10,041	257,156	20
	Services	21	8,747	5,306	16,803	1,894	3,343	1,745	2,288	7,562	358	5,332	4,157	23	630	3,788	25,398	7,726	9,410	12,235	6,345	6,754	27,244	14,406	300,236	210,120	13,600			79,675	775,125	21
	Construction	22																								62,366	63,449	308,185			434,000	22
	Households	23	159,064	35,193	73,465	13,285	88,410	12,878	17,128	36,663	4,548	58,628	64,025	2,880	10,530	104,932	479,854	92,789	91,258	218,200	170,600	75,400	461,600	177,200	25,624	148,809	528,400			170,637	3,322,000	23
OTHER PAYMENTS	State and Local Government		32,671	10,240	22,460	2,397	10,065	598	1,753	1,531	277	3,940	1,731	228	1,057	2,675	72,178	1,138	5,623	78,726	14,502	14,535	6,242	1,743	87,707		75,800			3,433	453,250	
	Federal Governments					13,081	17,018	1,612	3,436	13,835	782	4,188	9,225	1,162	7,378	25,118	116,000	18,181	860	17,408	8,232	15,850	3,025	3,054	423,700						703,145	
	Depreciation		40,003	27,019	92,478	10,262	4,850	2,341	2,401	3,666	319	2,377	3,914	1,434	3,581	7,857	42,450	1,544	6,725	41,000	19,161	35,797	42,125	9,500							400,804	
	Imports and Other Expenses		146,725	47,658	180,868	31,986	141,518	11,699	48,940	129,889	17,146	64,295	132,920	2,560	36,931	212,634	37,716	29,019	208,257	180,748	26,997	83,919	135,346	155,309	1,207,437	24,268		181,686			3,476,471	
	TOTAL PURCHASES		845,201	185,004	512,593	96,816	913,325	115,400	232,265	244,759	26,813	150,504	251,188	15,517	67,950	406,500	867,602	163,206	336,228	594,964	297,167	257,156	775,125	434,000	3,322,000	463,250	844,958	570,000	–5,940	3,161,402	16,145,850	

TABLE C.2
DIRECT REQUIREMENTS TABLE
NEBRASKA ECONOMY
1963

[Direct Purchases per Dollar of Gross Output]

			PURCHASING SECTORS																						
			AGRICULTURE			MINING AND MANUFACTURING											NON-COMMODITY								
			Livestock	Irrigation	Dryland	Mining	Meat Products	Dairy Products	Grain Products	Other Food	Farm Machinery	Other Machinery	Metals	Agri. Chemicals	Other Chemicals	Other Manufacturing	Trade	Finance	Insurance	Real Estate	Transportation	Utilities	Services	Construction	Households
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SELLING SECTORS – AGRIC.	Livestock and Livestock Products	1	.17824	.03059	.01382		.59588	.65226		.00050											.00005		.00009		.00505
	Irrigated Crops	2	.06150	.01474	.00383				.15185	.07349											.00050		.00004		.00023
	Dryland Crops	3	.08172	.00250	.01493				.34006	.00309															.00065
MINING AND MANUFACTURING	Mining	4	.00002	.00478	.00216	.10302			.00020	.00030			.00036	.17104	.00434	.03160				.00265	.00219	.00470	.00001	.02607	
	Meat Products	5					.04129		.01292	.00034							.00059				.00117		.00209		.01502
	Dairy Products	6						.02546		.00677							.00040				.00088		.00273		.01663
	Grain Products	7	.08885						.01004	.01294				.00400			.00038				.00059		.00117		.00012
	All Other Farm Products	8	.00006				.00003	.00579	.00047	.00169					.00602		.00141				.00030		.00460		.02823
	Farm Machinery and Equipment	9	.00001	.00069	.00004				.00113				.00014											.00001	.00018
	Other Machinery and Equipment	10					.00001	.00019	.00545	.00120	.01738	.00080	.00312	.01882		.00018					.00393	.00640			
	Metals	11		.00053			.00430		.00046	.01444	.03797	.00058	.06134			.01976				.00011	.00271	.00583		.01754	
	Agricultural Chemicals	12	.00005	.00837	.00561																				
	Other Chemicals	13				.00506	.00001	.00131	.00948	.00404	.00116	.00025	.00049	.00039	.00558	.00086	.00028			.00101	.00082	.00019	.00152	.00090	.00014
	Other Manufacturing	14	.00046	.00024	.00036	.00015	.00038	.00609	.00611	.01338	.00627	.00175	.01221	.00316	.03670	.01160	.00879	.01738	.01139	.00244	.00738	.00700	.00231	.00058	.00698
NON-COMMODITY	Trade	15	.03502	.04390	.04397	.01491	.01765	.02623	.04751	.03788	.03383	.03659	.03063	.02423	.02418	.02808	.01445	.00841	.00841	.01499	.02561	.00797	.02100	.08237	.14077
	Finance	16	.04056	.02676	.04537	.00874	.00134	.00014	.00615	.00247	.01029	.00046	.00191	.00102	.00673	.00095	.00295	.02545	.00164	.01936	.00350	.00345	.00313	.00182	.00496
	Insurance	17	.00223	.00319	.00521	.00212	.00016	.00037	.00028	.00042	.00071	.00062	.00034	.00129	.00131	.00066	.00299	.00062	.00129	.00586	.02210	.00238	.00403	.00051	.01352
	Real Estate and Rentals	18	.02316	.15820	.08860	.07673	.00064	.00334	.00196	.00192	.00403	.00696	.00057	.00039	.00104	.00357	.04621	.01197	.01362	.02046	.02615	.01427	.04487	.00400	.11409
	Transportation and Warehousing	19	.01950	.01247	.01249	.02609	.03839	.00377	.06544	.02723	.00664	.02146	.01466	.14068	.01762	.01082	.00416	.00888	.00384	.00557	.06371	.01313	.00532	.02977	.00151
	Utilities	20	.01048	.01512	.01041	.01014	.00955	.00749	.01349	.00878	.00791	.00854	.01442	.10092	.01191	.01368	.02575	.00577	.00174	.00596	.01116	.03152	.03551	.00413	.03642
	Services	21	.01035	.02868	.03278	.01956	.00366	.01512	.00985	.03090	.01335	.03543	.01655	.00148	.00927	.00932	.02927	.04734	.02799	.02056	.02135	.02626	.03515	.03319	.09038
	Construction	22																							
	Households	23	.18820	.19023	.14332	.13722	.09680	.11159	.07374	.14979	.16962	.38954	.25489	.18560	.15497	.25813	.55308	.56854	.27142	.36674	.57409	.29321	.59552	.40830	.00771
TOTAL NEBRASKA PURCHASES			.74040	.54099	.42290	.40374	.81009	.85915	.75659	.39157	.30916	.50298	.41163	.65302	.27967	.38921	.69071	.69436	.34134	.46571	.76819	.41631	.75909	.60919	.48259

TABLE C.3
TOTAL REQUIREMENTS TABLE
NEBRASKA ECONOMY
1963

[Total Direct and Indirect Requirements per Dollar of Sales to Final Demand]

			PURCHASING SECTORS																						
			AGRICULTURE			MINING AND MANUFACTURING											NON-COMMODITY								
			Livestock	Irrigation	Dryland	Mining	Meat Products	Dairy Products	Grain Products	Other Food	Farm Machinery	Other Machinery	Metals	Agri Chemicals	Other Chemicals	Other Manufacturing	Trade	Finance	Insurance	Real Estate	Transportation	Utilities	Services	Construction	Households
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SELLING SECTORS	AGRIC.	Livestock and Livestock Products 1	1.24204	.05363	.02985	.01071	.77846	.83799	.03626	.02111	.01030	.01985	.01415	.01701	.00928	.01356	.02748	.02766	.01338	.01811	.03101	.01527	.03310	.02250	.04281
		Irrigated Crops 2	.09675	1.02034	.00725	.00169	.06117	.06625	.16107	.07933	.00162	.00311	.00222	.00335	.00192	.00212	.00439	.00432	.00209	.00283	.00536	.00239	.00543	.00353	.00665
		Dryland Crops 3	.14235	.00921	1.01899	.00157	.08943	.09630	.35375	.01065	.00151	.00290	.00207	.00389	.00140	.00198	.00412	.00403	.00195	.00264	.00468	.00223	.00514	.00329	.00621
	MINING AND MANUFACTURING	Mining 4	.00235	.00835	.00450	1.11571	.00190	.00213	.00394	.00207	.00074	.00091	.00155	.19251	.00667	.03629	.00156	.00170	.00095	.00381	.00410	.00630	.00150	.03008	.00145
		Meat Products 5	.01064	.00788	.00632	.00538	1.05294	.01046	.02097	.00635	.00517	.00996	.00710	.00860	.00464	.00680	.01400	.01387	.00671	.00908	.01594	.00766	.01679	.01130	.02143
		Dairy Products 6	.01004	.00860	.00691	.00590	.00980	1.03654	.00802	.01333	.00567	.01093	.00779	.00931	.00512	.00746	.01511	.01524	.00738	.00997	.01703	.00841	.01886	.01239	.02353
		Grain Products 7	.11195	.00526	.00305	.00125	.07034	.07578	1.01384	.01532	.00119	.00228	.00162	.00604	.00115	.00154	.00349	.00314	.00153	.00205	.00409	.00174	.00490	.00260	.00476
		All Other Food Products 8	.01669	.01420	.01142	.00975	.01624	.02318	.01372	1.01227	.00939	.01804	.01286	.01521	.01443	.01233	.02566	.02514	.01217	.01646	.02685	.01387	.03108	.02047	.03883
		Farm Machinery and Equipment 9	.00031	.00080	.00012	.00006	.00023	.00024	.00135	.00014	1.00006	.00011	.00022	.00010	.00005	.00008	.00015	00016	.00008	.00010	.00017	.00009	.00017	.00014	.00024
		Other Machinery and Equipment 10	.00116	.00060	.00044	.00035	.00107	.00114	.00629	.00171	.01776	1.00121	.00370	.02040	.00031	.00058	.00055	.00045	.00021	.00031	.00468	.00690	.00066	.00053	.00054
		Metals 11	.00107	.00138	.00064	.00058	.00588	.00125	.00180	.01636	.04106	.00149	1.06629	.00185	.00136	.02192	.00133	.00141	.00074	.00086	.00437	.00715	.00141	.01965	.00145
		Agricultural Chemicals 12	.00167	.00860	.00578	.00002	.00105	.00114	.00333	.00072	.00002	.00004	.00003	1.00005	.00002	.00003	.00006	.00006	.00003	.00004	.00007	.00003	.00008	.00005	.00009
		Other Chemicals 13	.00161	.00068	.00050	.00607	.00121	.00265	.01021	.00462	.00147	.00078	.00090	.00198	1.00594	.00141	.00099	.00072	.00037	.00149	.00163	.00064	.00232	.00168	.00092
		Other Manufacturing 14	.00958	.00723	.00639	.00486	.00912	.01541	.01378	.01878	.01095	.00889	.01840	.01122	.04108	1.01698	.01821	.02732	.01612	.00912	.01833	.01275	.01273	.00932	.01379
	NON-COMMODITY	Trade 15	.14810	.12487	.10830	.07001	.14248	.15858	.14525	.10044	.08567	.13195	.10118	.11306	.07040	.09480	1.14269	.14095	.07271	.10195	.16763	.08212	.16120	.19198	.20271
		Finance 16	.06846	.03890	.05473	.01565	.04645	.04851	.03498	.01026	.01442	.00756	.00712	.01000	.01042	.00623	.01314	1.03578	.00655	.02650	.01451	.00927	.01441	.01033	.01410
		Insurance 17	.01420	.01270	.01272	.00896	.01318	.01340	.01229	.00746	.00616	.01108	.00785	.01388	.00645	.00785	.01660	.01461	1.00811	.01511	.03826	.01045	.01893	.01267	.02085
		Real Estate and Rentals 18	.13770	.23534	.14988	.13418	.11506	.12514	.12713	.06749	.04937	.09235	.06180	.09233	.04205	.06461	.15951	.12887	.07058	1.09770	.15188	.08019	.16904	.10483	.17611
		Transportation and Warehousing 19	.04263	.02191	.01975	.03476	.07116	.03490	.08454	.03565	.01117	.02815	.02077	.16232	.02235	.01667	.01182	.01684	.00769	.01091	1.07607	.01887	.01412	.03892	.00978
		Utilities 20	.04883	.04467	.03423	.03001	.05151	.05206	.04755	.03143	.02610	.04095	.03892	.13478	.02813	.03660	.06840	.04969	.02326	.03474	.05801	1.05711	.08255	.04226	.06377
		Services 21	.08915	.08986	.08267	.06175	.08251	.09900	.08260	.07621	.05121	.10381	.06690	.06943	.04262	.05726	.12076	.14213	.07379	.08327	.12278	.07986	1.13547	.11267	.14099
		Construction 22																						1.00000	
		Households 23	.56099	.47901	.38313	.32820	.54684	.57910	.44261	.35224	.31764	.61163	.43670	.51654	.28414	.41968	.82702	.85516	.41305	.56091	.90574	.47124	.90120	.69257	1.33456
TOTAL			2.75827	2.19402	1.94757	1.84742	3.16803	3.28115	2.62528	1.88394	1.66865	2.10798	1.88014	2.40386	1.59993	1.82678	2.47704	2.50925	1.73945	2.00796	2.67319	1.89454	2.63109	2.34376	2.12557