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A Study of the
Sweet Corn Industry
in the
Midwest Farm Economy

Richard A. Andrews

University of Minnesota
Agricultural Experiment Station

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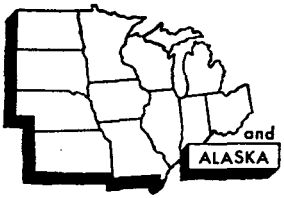

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CONTENTS

FOREWORD

This bulletin presents information on the economic relationships and historical developments in the sweet corn industry for the Midwest and the United States. Production and consumption trends, the position of sweet corn in the current setting, and the key role of processors in the industry are described. The demand for canned sweet corn, the Midwest supply of sweet corn for processing, and the competition of Midwest growers with growers in other production regions are analyzed. Projections for expected trends are developed.

Only descriptive and analytical data are presented. Historical series upon which the description is based are easily accessible elsewhere and are not included.

The study presented herein was approved by the North Central Regional Fruit and Vegetable Technical Committee in January 1956, as a phase of work in their studies of sweet corn in the North Central Region carried out under Regional Project NCM-13.

The study was made under the supervision of Willard W. Cochrane, Minnesota Agricultural Experiment Station. The author thanks Professor Cochrane for his assistance with the study. Responsibility for the text and the conclusions, however, is assumed by the author.

A Study of the Sweet Corn Industry in the Midwest Farm Economy

Richard A. Andrews[1]

INTRODUCTION

IN THE PAST THREE DECADES, the sweet corn industry has undergone a marked change, both in type of product marketed and in the area of production. Frozen sweet corn has been introduced and its market expanded. Sweet corn for fresh market has increased in importance. White cream-style canned sweet corn production has declined while golden cream-style and golden whole-kernel sweet corn production has increased. Wisconsin, Minnesota, and several far western states have risen in importance as producing areas of sweet corn for processing. Florida, Texas, and California have risen in importance as producing areas of sweet corn for fresh market.

To keep abreast of these industry developments, several Midwest regional studies have been made covering the economic aspects of marketing of fresh market sweet corn, the grade yield-price relationship of raw sweet corn sold to processors, and an analysis of existing pricing systems used in grower-processor markets.[2] To round out the work on the sweet corn industry in the North Central States, it seems desirable to look at the overall industry in the current setting and consider its potentialities as well as the problems that it may encounter.

OBJECTIVES

The primary objective of this project is to describe and appraise the prospective position of the sweet corn industry in the Midwest farm economy in the decade ahead. This involves such secondary objectives as describing the past and current economic position of sweet corn in the Midwest farm economy, appraising the role processors play in the industry, analyzing the prospective demand for sweet corn, and appraising the competitive position of sweet corn in the Midwest with other crops and other areas.

PROCEDURE

The above objectives will be approached along the following lines or by the following procedural steps:

1. The development of sweet corn as a vegetable will be described.

[1] Former Research Assistant, Department of Agricultural Economics, University of Minnesota; now Assistant Professor of Agricultural Economics, University of New Hampshire, Durham, N.H.

[2] See North Central Regional Publications Nos. 45, 81, 82, 85, and 86, all studies on sweet corn marketing by the North Central Regional Fruit and Vegetable Technical Committee. These are listed fully on the back cover.

2. Production, acreage, yield, marketing, and consumption trends will be examined.
3. The current economic position of the sweet corn industry in the Midwest farm economy will be described.
4. The role played by processors in the industry will be described and appraised.
5. The prospective demand for sweet corn will be estimated in terms of population growth, income elasticity, and the influence of technological advance (e.g., in processing and handling sweet corn).
6. The competitive position of sweet corn with other farm crops and the production response of Midwest farmers will be analyzed.
7. The competitive position of Midwest sweet corn producers with producers in other leading producing areas will be appraised.
8. The data, estimates, and analysis of points 1 through 7 will be summarized and integrated to shed light on the prospective position of the sweet corn industry in the Midwest farm economy during the decade ahead.

LIMITATIONS

The sweet corn industry is one that involves several products with unique characteristics. The scope of this study is limited to a description of the industry as a whole and an analysis of the most important product types.

Types of products include fresh frozen cut corn, frozen corn on the cob, canned white whole-kernel, canned white cream-style, canned golden whole-kernel, canned golden cream-style, specialty canned types, and canned mixed vegetables. Some corn is processed, held, and reprocessed into soups and the like.

Sweet corn for fresh market is widely produced in small quantities for local consumption and by a few large-scale operators for more distant markets. It makes up approximately 10 percent of the total Midwest production; this study will therefore be concerned primarily with sweet corn for processing.

PART I.

A DESCRIPTION OF THE SWEET CORN INDUSTRY

ORIGINS OF THE SWEET CORN INDUSTRY

Sweet corn, according to a popular belief, was a distinct plant food of American Indians during the pre-Columbian era and was passed along to white settlers during the 18th century. This view is contested by A. T. Erwin, who considers it a mutation of recent origin.[3] Erwin points out that "sweet corn is conspicuous by its absence from . . ." specimens of historic maize in archeological museums, and that the single ear of the Golden Bantam type found in the numerous collection of historical maize is a genetic mutation.[4] To substantiate his theory, Erwin points to three proven mutations from starchy kernels discovered in hand-pollinated stocks at Ames, Iowa, and mentions other mutations.[5] He concludes: "If we accept sweet corn as a mutation of field corn, then of course, no one area can be named as the home of sweet corn; mutations simply occur now and then wherever field corn is grown extensively . . . It would appear that sugar genes of field corn may have appeared at infrequent intervals from the time maize was first introduced into North America."[6]

Huelsen[7] points out that Mexican *maiz dulce*, a close relative of sweet corn of pre-Columbian origin, was grown for sugar prior to the introduction of sugar cane and sorghum; and that Indians used sweet corn in some ceremonies. From this, he says the Indian may have known about sweet corn and the commodity could have been handed down from generation to generation. Due to lower yield of sweet corn, however, field corn was the mainstay of the Indian's diet.

The first reference to the existence of sweet corn—and one evidently indisputable—is to be found in Thomas Jefferson's *Garden Book* (1810). Jefferson mentions "shriveled corn," now considered sweet corn.[8] In 1779, a Captain Bagnall is reputed to have carried seed from the Susquehanna Valley and introduced sweet corn near Plymouth, Massachusetts. The evidence substantiating this earlier date, however, is open to dispute.

By 1828 sugar, or sweet, corn was listed in a seed catalogue, but no variety name was given. The Massachusetts Horticultural Society made the first known recorded award for the best and earliest sweet corn in 1846 at the society's eighteenth annual exhibit. Huelsen concluded that sweet corn as a distinct crop had come into existence by 1820.[9] By 1853, two varieties were listed in the United States patent office report.

The processing of sweet corn had its beginning in the early part of the 19th century. Isaac Winslow of Portland, Maine, began experiments with canning corn in the 1830's. In 1843, he constructed facilities for commercial canning operations and there are records of some sales; but this first venture was a failure. Canning operations on a reg-

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[3] A. T. Erwin, "Anent the Origin of Sweet Corn, Zea Mays, L. var. rugosa, Bonaf.," *Iowa State College Journal of Science*, XVI, No. 4, July 1942, pp. 481-85.

[4] *Ibid.*, p. 481.

[5] A. T. Erwin, "Sweet Corn—Mutant or Historic Species?" *Economic Botany*, V, No. 3, July-September 1951, pp. 302-6.

[6] *Ibid.*, pp. 304, 306.

[7] Walter A. Huelsen, *Sweet Corn* (New York: Interscience Publishers, Inc., 1954), pp. 1-7.

[8] A. T. Erwin, "Sweet Corn—Mutant or Historic Species?" *Economic Botany*, V, No. 3, July-September 1951, pp. 302-6.

[9] Huelsen, *loc. cit.*

ular basis apparently began between 1843 and 1853, for in the latter year Winslow applied for his first patents on an "Improved Process of Preserving Green Corn."

In the Midwest, Thomas Duckwall pioneered vegetable canning operations in 1860 at Locust Corner, Ohio, 12 miles east of Cincinnati, and soon included sweet corn among his products. Gilbert Van Camp was the first to start operation in Indiana, at Indianapolis in 1861. It was 1878 before sweet corn canning reached Iowa; the first plant began that year at Marshalltown.

Once pioneered, product improvement and industry developments soon followed. New varieties were introduced rapidly. Mechanization of processing began in 1875 with the introduction of a hand-powered cutter invented by Volney Barker. The corn husker was developed in 1890.

"By 1908, with the advent of the husker, the cutter, the hot-pack process, and the sanitary can, the corn canning industry had entered the modern age of big business . . . The industry had passed through the early experimental stages, and with reasonable care the corn packer could now predict that spoilage would not wipe out his profits."[10] Adoption of the sanitary can introduced the serious problem of black discoloration which accumulated in the head space of the can. This was solved in 1922 by the addition of a trace of zinc oxide to the can lacquer.

SCOPE OF THE SWEET CORN INDUSTRY

Sweet corn has become a popular vegetable only in the United States and Canada. The Central and South American diet is still based on maize. In Mexico, green ears of field corn are offered on the commercial market.

Extensive canning operations are found in Canada where 55 to 95 million pounds are canned annually. This is about 1 can-unit for every 15 can-units processed in the United States.[11] The canned corn-on-the-cob style, almost nonexistent in the United States, enjoys some popularity in Canada.

Sweet corn is primarily a North American food—little enters foreign trade channels. No records of imports into the United States are to be found for the period 1949 to 1953, and exports averaged less than 100,000 cases (24 No. 2 can equivalents) during this period. Exports in the 1954 to 1956 period were double those of the preceding 5 years, but this change was due to increased exports to Canada. Countries other than Canada customarily importing sweet corn from the United States are, in order of volume imported: Cuba, Philippine Republic, Venezuela, Canal Zone, Switzerland, Belgium, Panama, and Japan. Military and economic ties with many of these sweet corn importing countries strongly suggest that canned sweet corn exports are or have been influenced by United States citizens residing abroad.

TRENDS AND DEVELOPMENTS IN THE SWEET CORN INDUSTRY

Sweet corn produced for *fresh market* and sweet corn produced for *processing* are unrelated products in several ways. Sweet corn for processing is usually produced under a contractual agreement which describes conditions for crop production and disposal. On the other hand, almost all sweet corn for fresh market is produced for open market sale. In marketing, it is the comparison of a highly perishable item with a semi-durable item.

In view of the differences existing between frozen and canned sweet corn and among types or styles of frozen and canned sweet corn, aggregation for describing the industry must follow type-of-product lines.

[10] Huelsen, *op. cit.*, pp. 272-73.

[11] See *The Canning Trade Almanac* (The Canning Trade, Baltimore 2, Md.), *passim.*

Production

The production of sweet corn for processing (canned and frozen) increased an average of 28,000 tons of corn in the husk per year from 1918 to 1957 in the United States. The trend-estimating equation is shown in table 1.

Where production is the resultant of yield and number of acres harvested, one would expect yearly production fluctuations—and they are, in fact, considerable (see figure 1). The standard error of the trend estimating equation is 193,000 tons, indicating that year to year variations in production are often seven times or more than the yearly average increase in production.

Table 1. Sweet corn trend-estimating equations, United States, 1918-57

Dependent variable	"a" value (1917=0)	"b" value	Standard error of estimate
		(in 1,000 units)	
Tons in husks of sweet corn for processing	349	+28	193
Cases of canned sweet corn (24 No. 2 can equivalent)	9,647	+549	4,717
Tons of sweet corn for fresh market*	47	+16	34
Harvested acreage of sweet corn for processing	228	+ 7	71

* For the period 1919 to 1955.

Source: Information supplied by AMS, USDA; *Canning Trade Almanac;* and sources listed for fig. 1 (*q.v.*).

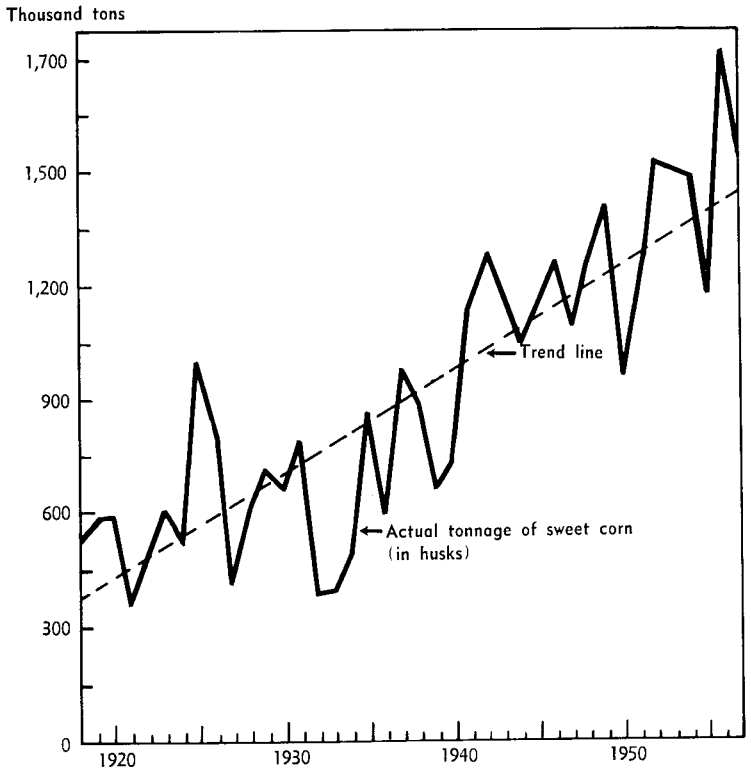

Fig. 1. Sweet corn production for processing, United States, 1918-57.

(*Source:* USDA Statistical Bulletin 132, *Vegetables for Commercial Processing, 1918-50;* USDA Statistical Bulletin 210, *Vegetables for Processing . . . 1949-55;* and *Vegetables—Processing, Annual Summary, 1957,* AMS, USDA.)

During the 1918 to 1957 period, the number of cases of canned sweet corn (24 No. 2 can equivalents) increased by 549,000 per year in the United States (table 1).

Yearly variations in amount canned depend on number of acres harvested, yield of sweet corn in tons per acre, and yield in cases of sweet corn per ton of husked corn. The standard error of the trend estimating equation is 4,717,-000 or about nine times the yearly average increase in production.

The relative position of the Midwest in sweet corn for processing is far more stable than the United States as a whole. (See figure 2. This says that Midwest production fluctuates with overall U. S. production.) Over the period 1918 to 1957, the Midwest produced about 70 percent of the sweet corn for processing in the United States, reaching its highest position during 1929 and 1931 and a second high during World War II, with about 75 percent of the United States total. The greatest yearly fluctuation in production occurred between 1935 and 1937, when a drought occurred and when market channels may have been undergoing a change as a result of the shifts in production area.

In the post-World War II years, the relative position of the Midwest declined to less than 70 percent of the United States production of sweet corn for processing and yearly fluctuation increased. This period is marked by the rise in the relative position of the far western states (Washington, Oregon, Utah, and Idaho) and further weakening of the relative position of eastern and other states.

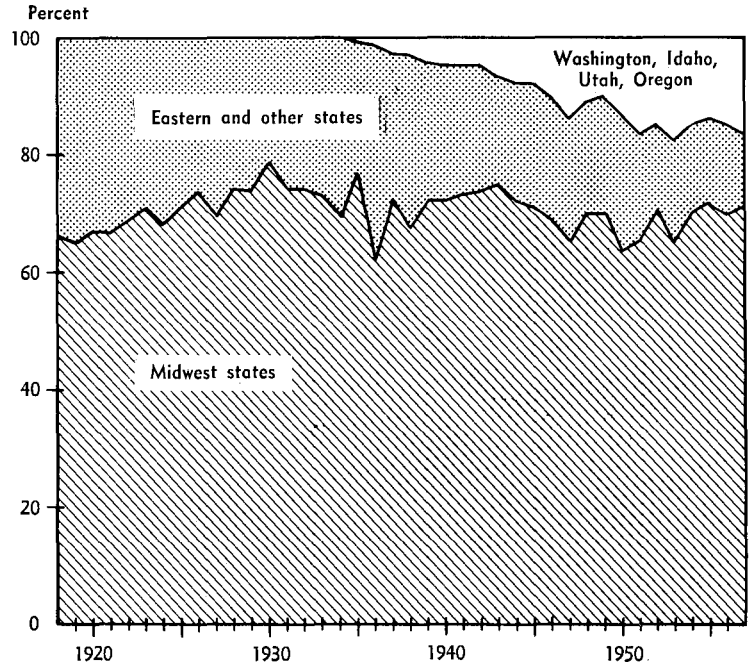

Fig. 2. Percentage distribution of United States sweet corn production for processing by region, 1918-57.

(Source: See source for fig. 1.)

Although the Midwest's relative position in sweet corn production has deteriorated modestly in recent years, actual production has increased and importantly so. Between the pre-World War II period of 1935 to 1939 and the 5-year period of 1950 to 1954, sweet corn production in the six leading states increased by 60 percent (the increase is discussed below in detail).

An important shift occurred within the Midwest (see figure 3). Minnesota, Wisconsin, and Illinois increased in relative importance from the position of producing about 40 percent of the Midwest total in 1918 and 1919 to about 85 percent in 1956 and 1957.

FRESH MARKET. A historical series describing production of fresh market sweet corn is not available for the Midwest. Data by states for some 26 states have been estimated since 1949. Fresh market sweet corn production in the United States, presented here, is for the period 1919 to 1955 and is the estimate employed by the Agricultural Marketing Service (formerly Bureau of Agricultural Economics), USDA, in estimating per capita consumption. From 1919 to 1955, the production of fresh market sweet corn increased an average of 16,000 tons per year.

Acreage

The harvested acreage of sweet corn for processing increased an average of 7,000 acres per year from 1918 to 1957 in the United States (table 1). The standard error of trend estimate is 10 times the yearly average increase. The presence of a 5- to 7-year cycle (as can be seen in figure 4) explains a large

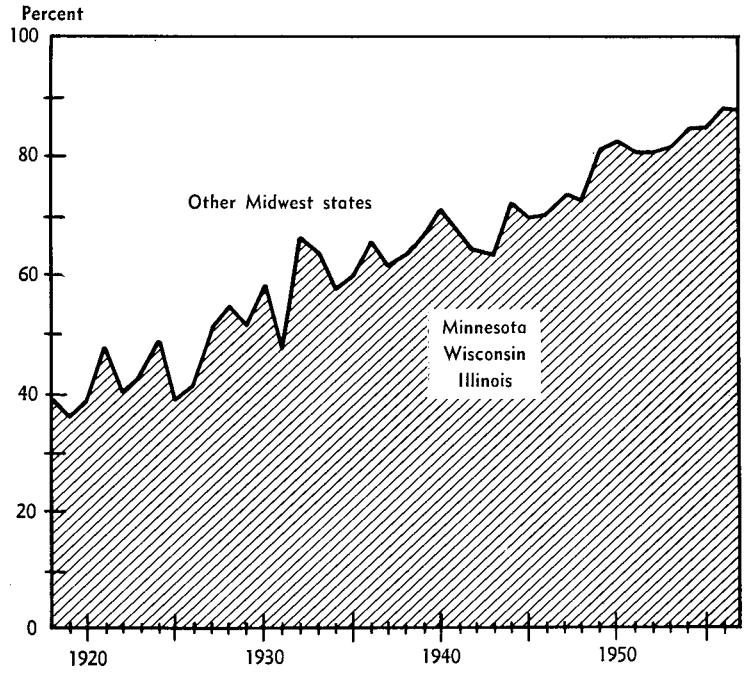

Fig. 3. Percentage distribution of Midwest sweet corn production for processing, selected Midwest states, 1918-57.

(Source: See source for fig. 1.)

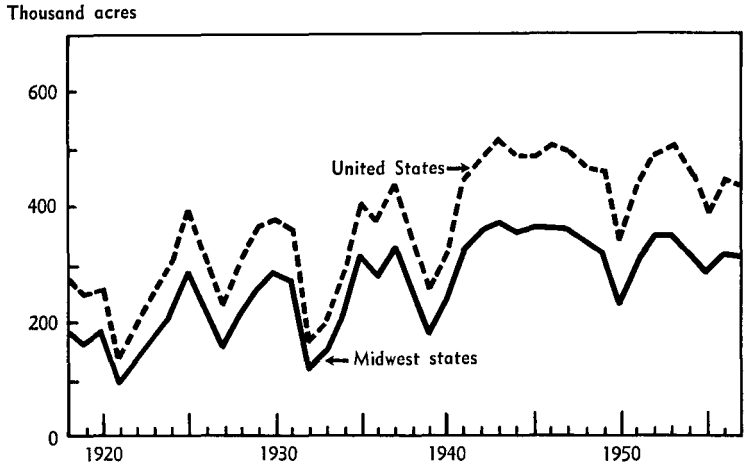

Fig. 4. Harvested acreage of sweet corn for processing, Midwest states and United States, 1918-57.

(Source: See source for fig. 1.)

part of the standard error. (A low point which should have occurred in 1944 or 1945 did not materialize, principally due to wartime food requirements.)

Canners' stocks appear to have an important bearing on the cycle. The calendar year of low harvested acreage is the year of large inventory carryover. For example, note in figure 5 the large canner carryover in 1950 and 1955, years of low harvested acreage in the post-World War II period.

In considering the cycle, the nature of the sweet corn processing industry must be briefly sketched. The market year for the canned product runs from August 1 to July 31. During January and February processors make their plans, in terms of cases desired and acreage needed, concerning quantity of new product to be processed. But these plans can be revised at any time until planting begins. The acreage is contracted with farmers between February and May. Planting starts the last of April and continues to the end of June. Harvesting and processing are done between late July and late September. Thus, plans determining the amount of sweet corn produced for processing are made during the last half of the previous market year.

Inventories on hand during the planning period influence production plans. Canner carryover stocks (i.e., canner stocks as of August 1) can be anticipated early enough in the year so that production plans can be altered. Canners prefer that carryover stock be small to keep storage costs and product deterioration at a minimum. Moreover, large inventories plus current production indicate a large supply, which will depress the price processors receive for their product. Thus, processors will want to correct the problem of large inventories and low product prices by curtailing production. Planned production curtailment comes by way of acreage reduction. This may be done either by reducing the contract price, thereby lessening the farmer's desire to grow sweet corn for processing, or through grower acreage restriction activities or both.

Thus, the cycle can be traced to carryover stocks and processor inventories. Carryover stocks can be

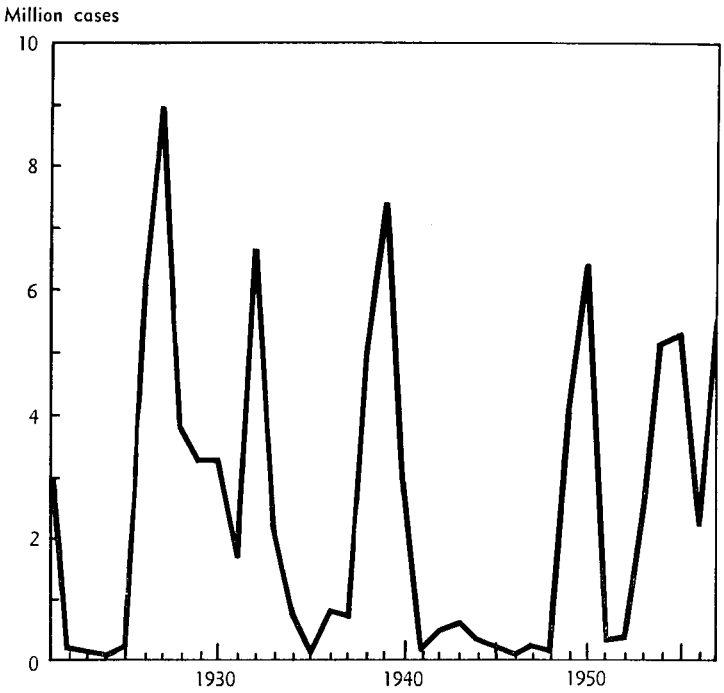

Fig. 5. Carryover stock of canned sweet corn, canner's stock, as of August 1, United States, 1921-57.

(Source: Canning Trade Almanac and R. A. Kelly, Vegetable Canning Industry in Illinois, Ill. Agr. Expt. Sta. Bul. 612, June 1957.)

built up during a year of high crop yields and by canners responding to favorable product prices and increasing acreage; but once produced, stocks are held into the second market season in hopes of a more favorable price.

SHIFTS IN LOCATION OF SWEET CORN ACREAGE. From 1918 to 1957, the Midwest has maintained a position of growing about 70 percent of the sweet corn acreage for processing in the United States. But during this period, sweet corn acreage for processing shifted within the Midwest area from Ohio, Indiana, and Iowa to Minnesota and Wisconsin. In 1918 Ohio, Illinois, and Iowa were the leading states. Minnesota began to grow in relative importance during the early 1920's and Wisconsin in the mid-1930's (figure 6).

Shifts in the location of sweet corn acreage can be traced on a more refined basis by counties. Aggregating sweet corn for processing and for fresh market, it was grown in amounts of more than one acre in 520 of the 539 counties of the six leading midwestern states and over 100 acres in almost half of these counties in the census year, 1954. On the other hand, over half of the acreage was concentrated in 32 counties containing 3,000 or more acres of sweet corn. The areas of concentration and the shifts in these areas can be seen by comparing figures 7 and 8, based on the census years 1934 and 1954. The sweet corn acreage was concentrated in central and southern Minnesota, central Wisconsin, and northern and eastern Illinois in 1954.

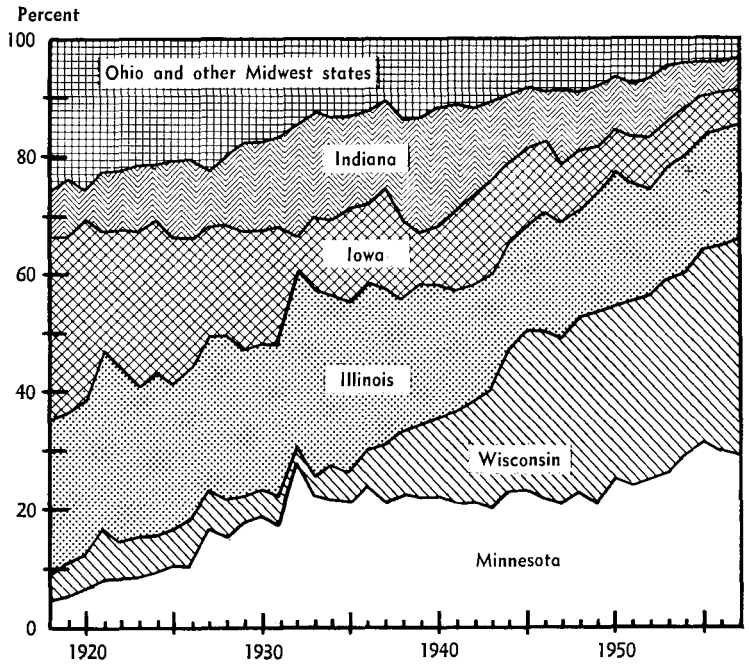

Fig. 6. Percentage distribution of Midwest sweet corn acreage harvested for processing by states, 1918-57.

(*Source:* See source for fig. 1.)

Production for processing played a dominant role in the concentration of acreage. With a few exceptions, areas of sweet corn concentration are also areas of heavy processing activities. The major exceptions to this are counties near large cities where there is a ready nearby market for fresh sweet corn. But acreage in the counties surrounding Chicago and St. Louis (Cook, Du Page, St. Clair, and Madison) decreased between 1934 and 1954. This suggests the possibility that fresh market production is moving from nearby market gardens to more distant areas of production. Evidence (yield and county production data) to support a conclusion that fresh market sweet corn production is moving to more distant areas is not available on a historical basis.

ACREAGE PER FARM. Shifts in acreage and a changing agriculture have carried with them an increase in average acreage of sweet corn on the farms that grow it. Average acreage per farm in the leading producing states of Indiana, Illinois, Minnesota, and Wisconsin more than tripled—and in Ohio and Iowa about doubled—between 1919 and 1954 (table 2). Each of these states is a major producer of sweet corn for processing and all but Ohio averaged 10 or more acres per farm growing sweet corn in 1954.

Production for processing is far less important in the remaining Midwest states and the fresh market production of small market gardeners clustered around urban areas plays a more important role in the state total. The small acreages that are grown by market gardeners substantially reduced the average to less than 4 acres per farm in the other Midwest states.

Table 2. Average acreage of sweet corn per farm growing sweet corn, Midwest states, census years 1919 to 1954

Year	Wisconsin	Minnesota	Illinois	Indiana	Iowa	Ohio
1919	2.8	2.5	6.2	3.3	6.4	2.9
1924	2.4	4.6	7.8	4.2	6.3	2.6
1929	2.9	8.7	10.4	5.0	7.2	3.2
1934	2.8	8.8	9.8	4.8	5.5	2.5
1939	4.4	9.5	9.9	7.0	5.6	3.8
1944	7.6	13.5	12.5	7.5	8.1	4.4
1949	9.5	15.1	18.6	8.5	8.9	4.2
1954	11.8	19.1	20.7	10.0	13.0	4.4

Year	Michigan	Missouri	North Dakota	South Dakota	Nebraska	Kansas
1919	2.0	1.2	0.7	1.0	5.5	1.6
1924	2.2	1.1	0.4	1.2	3.0	1.4
1929	2.3	1.1	0.8	1.1	4.4	1.5
1934	1.8	1.9	1.5	2.2	2.6	1.8
1939	2.3	1.9	1.3	2.3	3.9	2.0
1944	2.8	2.6	1.0	3.4	3.4	2.5
1949	2.7	1.9	1.3	1.9	4.6	3.0
1954	3.8	NL*	NL	NL	NL	NL

Source: Census of Agriculture, USDC. * Not listed.

Yield

The yield of sweet corn for processing is an aggregate of yields of different varieties of sweet corn and different products for which the sweet corn is grown. Yields vary between commonly used varieties—white and yellow varieties and among yellow varieties. It is commonly accepted that yields are determined by quality and style of pack to be processed. In viewing sweet corn yields over time, the occurrence of any major shift in type of product must be considered as possibly influencing yield trends.

In the next section, a shift from white cream-style to golden whole-kernel will be shown to have occurred. The shift from *white* to *golden* should have brought higher yields and the shift from *cream-style* to *whole-kernel* should have brought lower yields.

No clear-cut trend in United States average yield is noticeable from 1918 to the late 1940's, when an increasing yield trend developed (figure 9). Yields climbed during late years about 40 percent from those of the pre-World War II period of 1935-39.

In the six leading Midwest producing states, Indiana was the only state that did not show an appreciable yield increase until the very recent years (table 3). Gains over the 1935-39 period ranged from 0.7 tons in Ohio to 1.3 tons in Illinois.

Table 3. Average yield of sweet corn for processing, select Midwest states and the United States, by time period, 1920-57*

Period	Ohio	Indiana	Illinois	Wisconsin	Minnesota	Iowa	United States
				(tons)			
1920-24	2.1	2.4	2.3	2.2	2.5	2.4	2.29
1925-29	2.2	1.9	2.2	2.0	2.4	2.6	2.18
1930-34	1.8	1.7	2.0	2.3	2.3	2.2	2.00
1935-39	2.0	1.7	2.3	2.0	2.6	2.1	2.24
1940-44	2.0	1.6	2.5	2.5	2.9	2.4	2.38
1945-49	2.4	1.9	2.6	2.4	2.8	2.5	2.56
1950-54	2.7	1.8	3.1	2.8	3.3	2.7	3.00
1955-57	2.7	2.5	3.6	3.1	3.7	3.2	3.43

* Simple 5-year average. *Source:* See source for fig. 1.

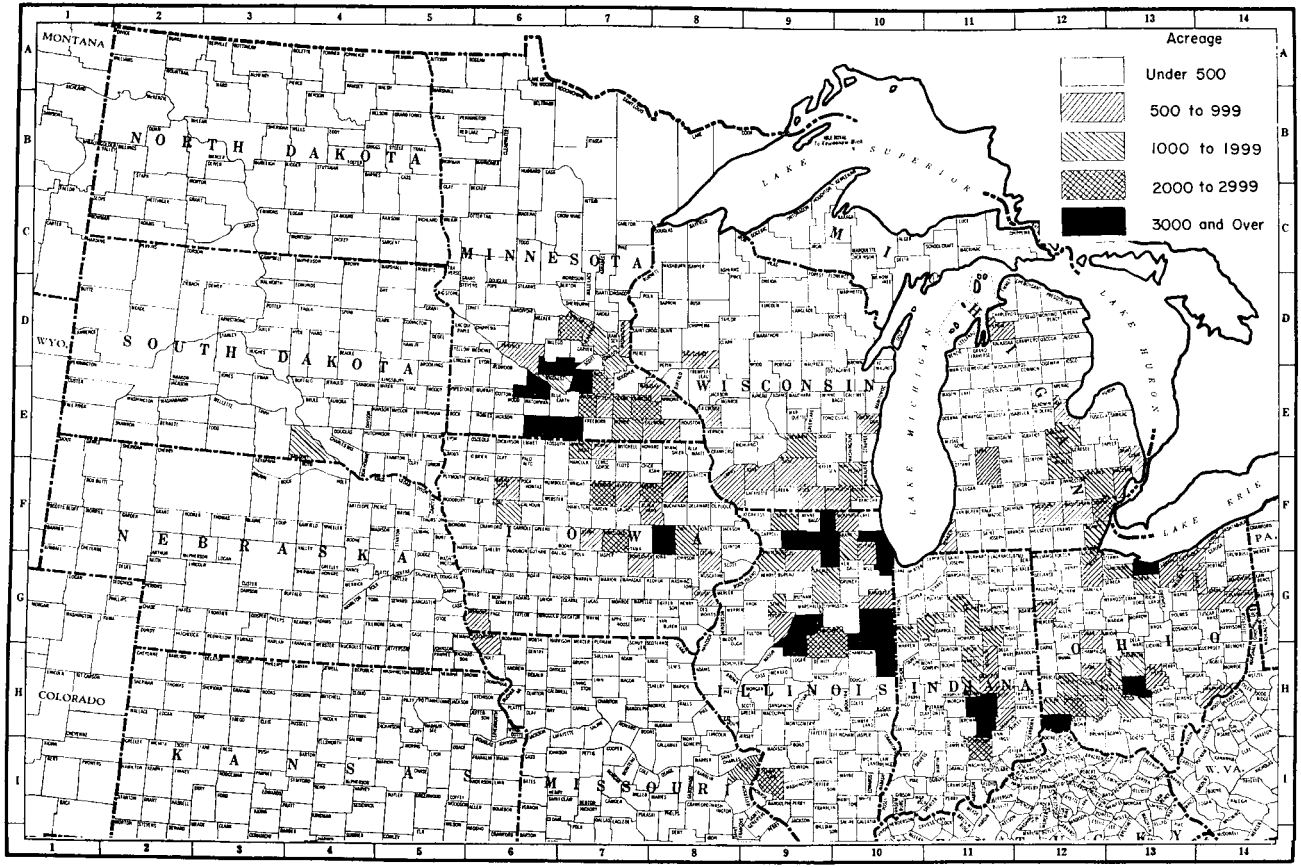

Fig. 7. Sweet corn acreage for fresh market and processing, Midwest, 1934.

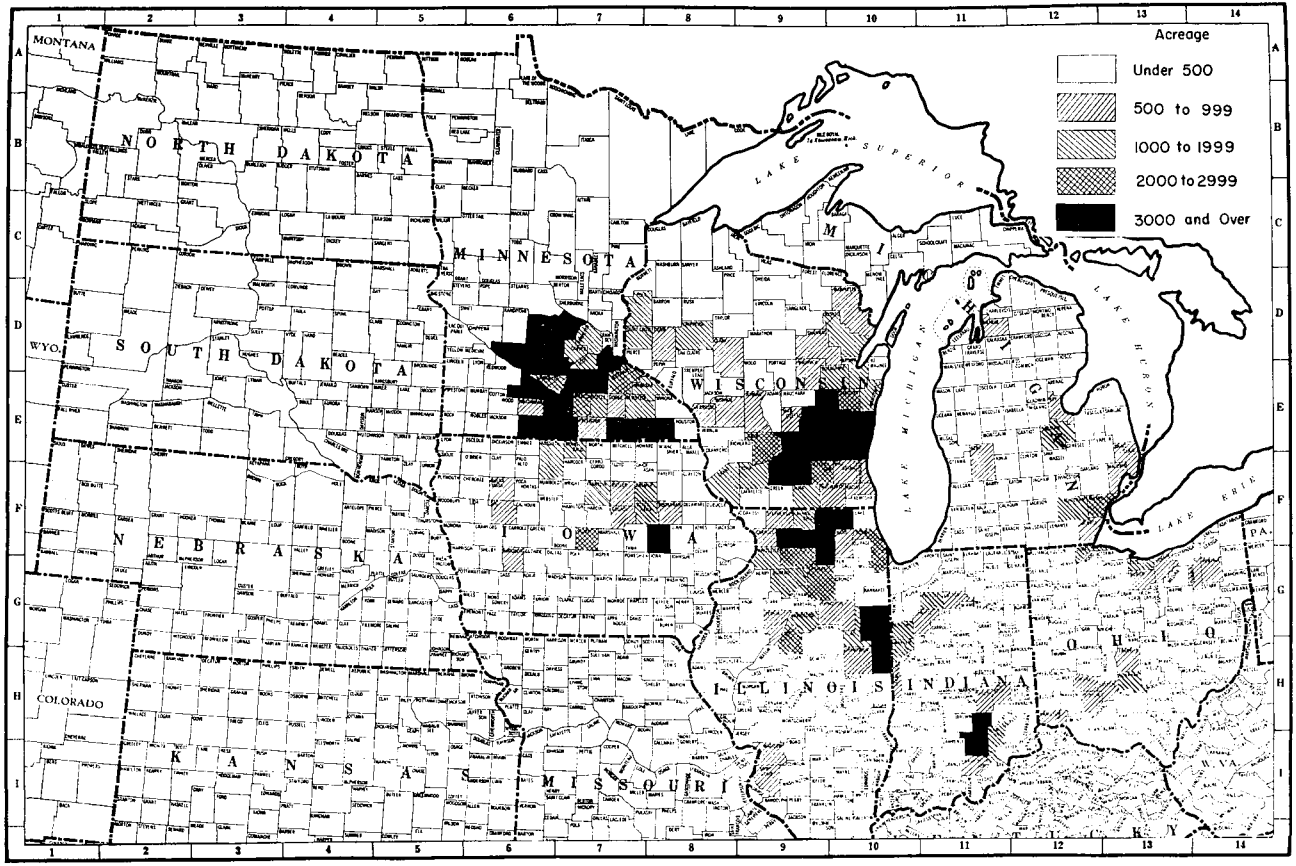

Fig. 8. Sweet corn acreage for fresh market and processing, Midwest, 1954.

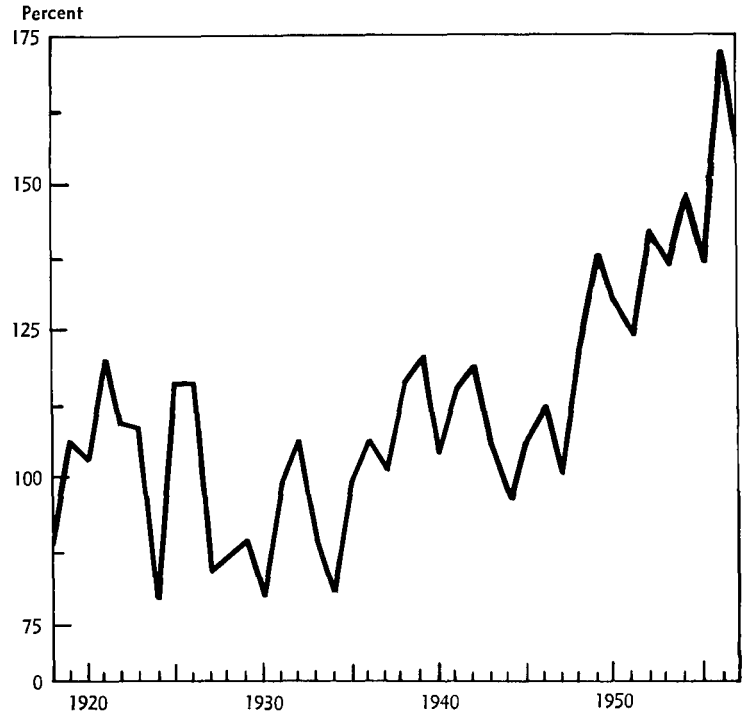

Fig. 9. Yield of sweet corn for processing as a percentage of the 1935-39 weighted average, United States, 1918-57.

(Source: See source for fig. 1.)

Since the 1935-39 pre-World War II period, higher yields have been obtained in Minnesota than in the five other states. Illinois yields were second highest. Yields in Wisconsin and Iowa were about equal and higher in each case than yields in Ohio and Indiana.

However, when considering shifts in production area and the competition between states, direct comparisons of actual yield per acre are beclouded by the style of pack. Wisconsin and Minnesota pack mostly whole-kernel, whereas Ohio and Indiana pack mostly cream-style. (See table 4.) Because greater yields per acre are commonly obtained for sweet corn packed as cream-style than packed as whole-kernel, Wisconsin and Minnesota are in a more favorable competitive position yield-wise.

Recent regional research done at Ohio State University indicates that among 320 growers, those who contracted with plants processing only cream-style corn in Ohio, Indiana, and Wisconsin had yields of 0.79 and 0.67 tons per acre higher than growers contracting with plants that processed only whole-kernel in 1955 and 1954 respectively.[12] Because approximately 70 percent of the Minnesota and Wisconsin pack of sweet corn is whole-kernel, reported yields are up

[12] R. G. Kline and M. E. Cravens, *Grower-Processor Agreements in the Sweet Corn for Processing Industry*, Ohio Agr. Exp. Sta. Bul. 806, June 1958 (N. C. Reg. Pub. 85), p. 40.

Table 4. Percentage distribution of sweet corn pack by style of pack, select Midwest states and the United States, 1954 and 1955

State	Golden whole-kernel	Golden cream-style	Total white	Total actual cases, 1954-55
	(percent)	*(percent)*	*(percent)*	*(millions)*
Wisconsin*	73	24	3	6.8
Minnesota*	68	31	1	7.8
Illinois*	34	40	26	6.0
Indiana†	5	95	.....	1.3
Ohio†	10	90	.....	0.7
United States	49	41	10	33.0

* Data supplied by state canners associations.

† Data from survey of processors conducted by Ohio State University. White styles are not separated from golden styles.

to 0.5 tons lower than they would have been if these states packed all cream-style.

Per Capita Consumption

In addition to population increases, an increase in per capita consumption contributed to the expansion of the sweet corn industry described above. Per capita consumption of sweet corn on a fresh, farm weight base more than doubled between 1920-24 and 1955-57 (see table 5). Fresh sweet corn consumption tripled during the period to 8.10 pounds per capita in 1955-57. Canned sweet corn consumption held rather constant between 1920 and 1939 at 8 to 9 pounds, then moved up to a higher plateau of 12 to 13 during World War II. Frozen sweet corn was developed during the 1930's and per capita consumption has increased steadily, reaching 2.46 pounds in 1955-57. Even though proportional increases in consumption were greater for fresh and frozen, canned sweet corn still comprises well over half the 24.09 pounds per capita consumption of all types of sweet corn.

Shifts in Sweet Corn Marketed

The last three decades in the sweet corn industry are marked by variety developments, introduction of new processing techniques, occurrence of insect problems and development of problem solutions, improved transportation, and new technologies in general. Many new developments effected an impact on the type of product marketed. It is important to note some of the major changes in sweet corn marketing.

Table 5. Civilian per capita consumption of fresh, canned, and frozen sweet corn by period, United States, 1920-57*

Years	Per capita consumption			
	Fresh	Canned	Frozen	Total
		(pounds)		
1920-24	2.52	8.82	.....	11.34
1925-29	3.16	9.87	.....	13.03
1930-34	4.90	8.66	.....	13.56
1935-39	5.34	9.98	0.13†	15.45
1940-44	6.30	12.75	0.24	19.29
1945-49	7.92	13.94	0.82	22.68
1950-54	7.88	12.84	1.49	22.21
1955-57	8.10	13.53	2.46	24.09

* Reported on a fresh weight basis.

† Three-year average—no information before 1937.

Source: The Vegetable Situation, AMS, USDA, July 1958, and information supplied by AMS, USDA.

FRESH MARKET. A most important change in fresh market sweet corn marketings to be noted is the rise in importance of the out-of-season production. Winter, early spring, and fall production rose in importance from 15 percent of the fresh market production in 1949 to almost 30 percent in 1956, declining to 28 percent in 1957 (figure 10). The shift in relative importance is explained primarily by the faster increases in winter, early spring, and fall production. Only early summer production decreased between 1949 and 1957.

The Midwest late summer producing states of Ohio, Illinois, and Michigan produced about 15 percent of the 26-state total production during all 7 years for which data are available (figure 11).

Missouri and Kansas, which are early summer producing states, did not fare as well. Their meager contribution in the 26-state total declined during the period.

Thus, the fresh market sweet corn marketing trend is toward increasing importance of winter, early spring, and fall seasonal production, a stable relative importance of Ohio, Illinois, and Michigan, and a declining importance of Kansas and Missouri.

CANNED SWEET CORN. Production techniques and variety developments have determined, to a large degree, the style of canned corn marketed. Until the late 1920's most canned sweet corn was of white varieties; high yielding yellow varieties of satisfactory quality were not available. Introduction of improved strains and hybrids of yellow varieties began in the late 1920's.

The introduction of Volney Barker's cutting machine in 1875 began a period when available technology became an important factor in the style of cut. The cream-style cutters preceded whole-kernel cutters by about 40 years. Although whole-kernel cutters were on

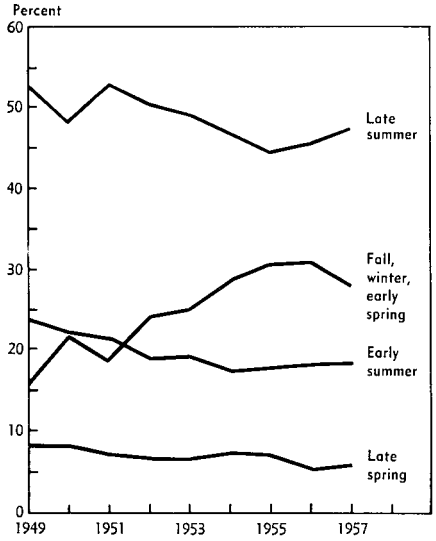

Fig. 10. Percentage of U. S. total commercial fresh market sweet corn production by season, 1949-57.

(Source: USDA Statistical Bulletin 212, Vegetables for Fresh Market . . . 1949-55; and Vegetables—Fresh Market, Annual Summary, 1957, AMS, USDA.)

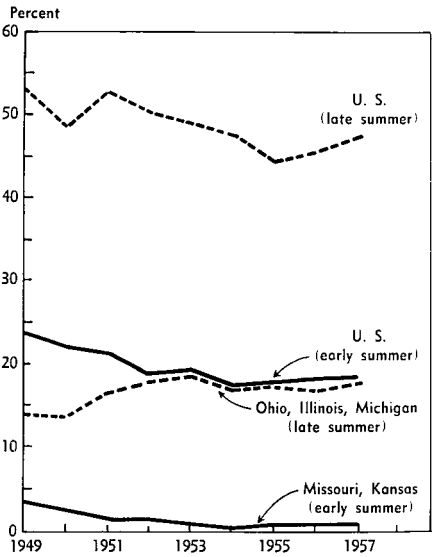

Fig. 11. Percentage of U. S. commercial fresh market sweet corn production by seasonal varieties and production in selected Midwest states, 1949-57.

(Source: See source for fig. 10.)

the scene before 1920, it was not until the late 1920's that technology reached a level where it no longer determined style of cut.[13]

Thus, the choice of style or color of canned sweet corn could be made on an equal basis. A shift in style of sweet corn packed from predominantly white cream-style to golden whole-kernel took place. This shift is dramatically portrayed in figure 12. The white cream-style pack decreased from a position of about 50 percent of the total pack in 1934 to less than 10 percent in 1957. The golden whole-kernel pack increased from about 12 percent of the total in 1934 to over 50 percent in 1957. Proportional shifts in the positions of white whole-kernel and golden cream-style were not so pronounced. White whole-kernel dropped from about 8 percent of the total pack to about 3 percent, while golden cream-style increased from a little less than 30 percent to about 40 percent between 1934 and 1957.

The shift in relative importance of the different styles of pack took place as actual production of golden whole-kernel and golden cream-style increased, as actual production of white whole-kernel remained at about a con-

[13] Huelsen, *op. cit.*, pp. 259-77.

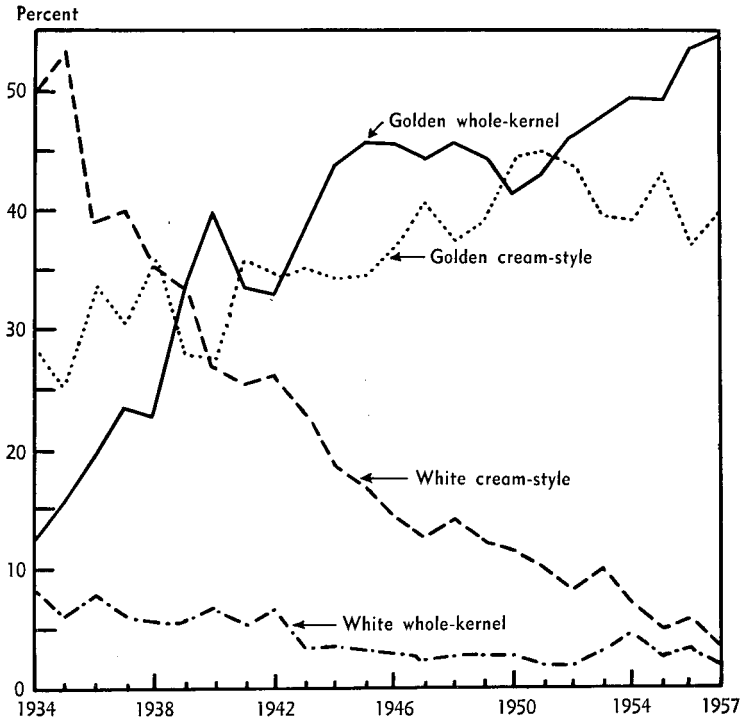

Fig. 12. Distribution of canned sweet corn pack: percentage pack by style and color, United States, 1934-57.

(Source: Canning Trade Almanac)

stant level, and as actual production of white cream-style decreased. The production of white cream-style decreased from about 8 million cases in 1934 to about 2 million cases in 1955 (figure 13).

The Midwest was and is the leading producing region for white cream-style corn, and the shift in relative position and actual decreased production would be expected to have an impact. The impact would be particularly pronounced if the shift from white sweet corn production to yellow sweet corn production was a difficult one arising from biological differences in the two types of corn, i.e., a shift from an adaptable white corn variety to a less adaptable yellow corn variety with a loss in competitive advantage. And this appears to be the case in several Midwest states.

Illinois, Indiana, Iowa, and Nebraska were the leading white cream-style producing states in the late 1930's and early 1940's. But by 1954 and 1955 the production of white cream-style sweet corn was sizable only in Illinois, where it remained fairly constant between 1936 and 1955. Indiana, Iowa, and Nebraska production decreased from 1 million and 3.5 million cases, respec-

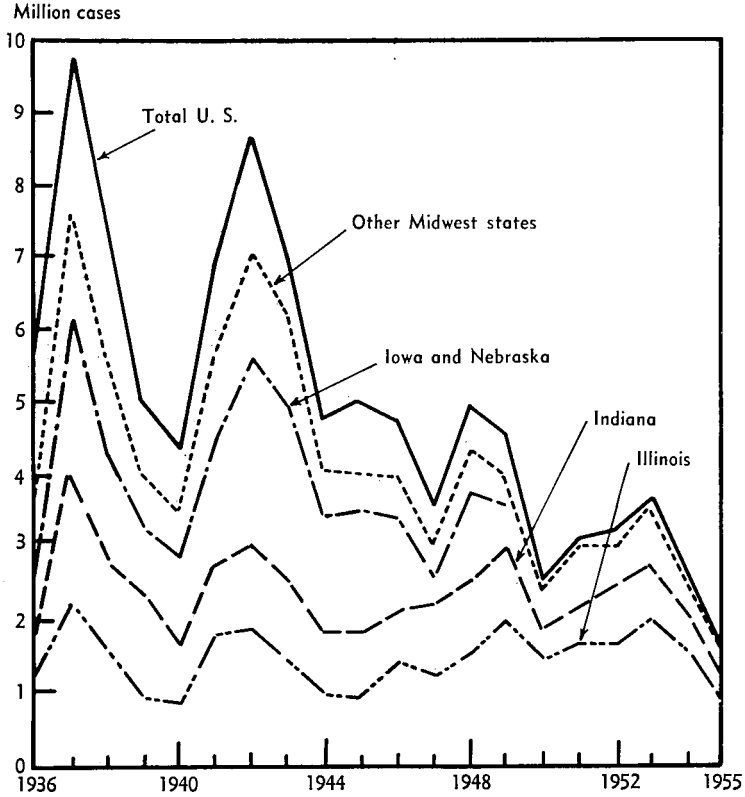

Fig. 13. Cases of white cream-style packed in selected Midwest states and the United States, 1936-55.

(*Source: Canning Trade Almanac* and data supplied by state canners' associations in Illinois and Indiana.)

tively, in the high production years in the early 1940's to about 200,000 cases in 1954 and 1955. These losses in the white cream-style market and the failure to find a satisfactory yellow variety for processing a golden style appear to be a major reason for the decline in sweet corn production in Indiana, Iowa, and Nebraska described in a previous section.

The rise in importance of Wisconsin as a producing state paralleled, and the production in Minnesota expanded with, the shift to golden sweet corn—particularly golden whole-kernel. It would appear, then, that Wisconsin and Minnesota have some competitive advantage for producing golden sweet corn which Indiana, Iowa, and Nebraska lack.

A style of canned corn not often mentioned is corn on the cob. It reached some degree of popularity prior to World War II, when frozen foods were in their infancy. After the war, frozen foods became more popular and widespread, and frozen corn on the cob took over the processed cob market. In 1957, few firms were canning corn on the cob and the total pack was small.

FROZEN SWEET CORN. In 1957 a quantity of about 20 million pounds was frozen in the United States. The trend in production of frozen corn on the cob is shown in figure 14 (3-year moving average). Production of frozen corn on the cob was well under way prior to World War II, but it was in the early postwar years that substantial increases occurred.

Production of frozen cut corn shows greater gains than that of corn on the cob, but some of the cut corn processed is later reprocessed into other styles of products, such as soups and succotash. Thus, the data do not indicate the marketings or marketing trends of cut corn for consumer sale as frozen cut sweet corn.

The Far West is by far the leading producing area of sweet corn, accounting for about half the United States production of both on the cob and cut styles (table 6). With a few yearly exceptions, the eastern and southern producing areas have frozen more sweet corn than the Midwest.

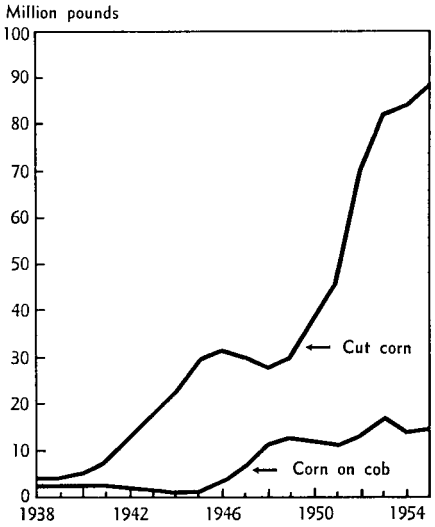

Fig. 14. Frozen sweet corn production in the United States, 1938-55 (3-year moving average).

(Source: Agricultural Statistics, USDA.)

SWEET CORN'S SHARE OF THE CANNED VEGETABLE PACK

Even with an average increase of half a million cases per year, canned sweet corn production only kept pace with the increase in total canned vegetable production (figure 15). Between 1931 and 1956, sweet corn production has fluctuated around 20 percent of the vegetable pack (including sweet corn, tomatoes, green peas, snap beans, asparagus, lima beans, beets, carrots, sauerkraut, spinach, pumpkin, and squash). Where the sweet corn production was low relative to canned vegetable production, during the years canners' carryover was highest, variations in the position of sweet corn with other canned vegetables appear associated with the cycle discussed previously.

MARKET AREA FOR MIDWEST CANNED SWEET CORN

Sweet corn is canned in several regions of the United States. One of the first steps in describing the market area for Midwest canned sweet corn is that of estimating the importance of production in other areas. This is done by estimating per capita production for major producing areas. (See table 7.) Yearly variations that occur are, for the most part, removed by averaging the figures for 1954, 1955, and 1956. The

Table 6. Frozen sweet corn production by type and region, 1946-56

Year	East and South		Midwest		West	
	Cut corn	Corn on cob	Cut corn	Corn on cob	Cut corn	Corn on cob
			(1,000 pounds)			
1946	10,199	548	3,816	89	23,412	1,659
1947	5,127	538	4,150	459	17,282	5,067
1948	6,718	3,095	3,391	1,649	10,810	5,582
1949	10,497	4,490	6,989	3,056	19,590	10,017
1950	14,189	4,469	4,943	1,518	13,866	4,082
1951	13,617	3,897	6,339	1,269	24,593	3,605
1952	15,592	3,467	12,258	2,576	34,834	8,153
1953	21,287	4,409	18,254	2,606	65,268	10,202
1954	14,635	2,725	21,338	5,038	42,239	9,025
1955	14,858	1,019	26,946	1,588	28,237	4,325
1956	28,578	3,038	36,069	3,635	53,506	13,749

Source: Agricultural Statistics, USDA.

Table 7. Per capita production of canned sweet corn, select states and regions and United States, 1954-56

State or area	Average 1954-1956 production*	1955 population	Pounds produced per capita†
	(number thousands cases)	*(thousands)*	*(pounds)*
New England	427	9,619	1.1
New York	1,143	16,021	1.7
Maryland and Delaware	1,889	3,034	14.9
Pennsylvania	714	10,898	1.6
Other states	100	11,845	.....
Total, Eastern states	4,273	51,417	2.0
Ohio	789	8,945	2.1
Indiana	1,122	4,329	6.2
Illinois	6,588	9,301	17.0
Wisconsin	8,546	3,702	55.4
Minnesota	8,156	3,190	61.4
Iowa and Nebraska	2,111	4,065	12.5
Other states	425	14,915	.....
Total, Midwest	27,737	48,447	13.8
West—8 states‡	4,607	21,150	5.2
Total, Mountain and Pacific	4,607	23,185	4.8
Other states	130	41,254	.....
Total, United States	36,747	164,303	5.4

* On basis of 24 No. 303 can cases.

† Case converted to pounds of processed product on basis of 24 pounds per 24-can case of No. 303 cans.

‡ Includes Washington, Oregon, California, Idaho, Montana, Wyoming, Colorado, and Utah.

Source: Compiled from *Canning Trade Almanac*, and *Statistical Abstract of the United States, 1957*, Bureau of Census, USDC, table 7, p. 10.

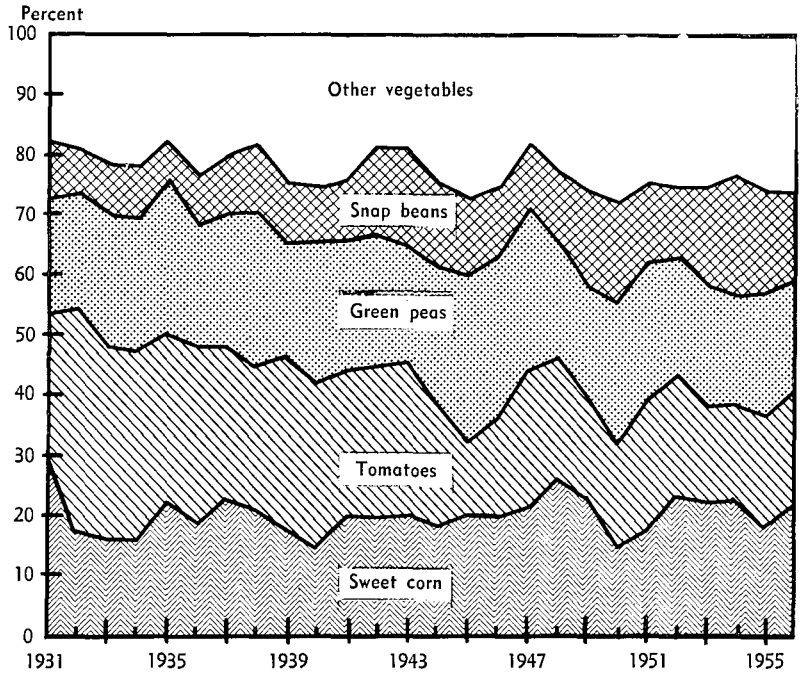

Fig. 15. Relative importance of specified canned vegetables in the U. S. vegetable pack, 1931-56. ("Other vegetables" includes asparagus, lima beans, beets, carrots, spinach, sauerkraut, pumpkin, and squash.)

(Source: Agricultural Statistics, USDA.)

per capita production data presented here are obtained by dividing the average production for 1954-56 by the population for 1955.

Average per capita production in the United States so developed amounted to 5.4 pounds (compared with 5.3 pounds per capita consumption reported by the Agricultural Marketing Service). Among the leading Midwest producing states, only Ohio produced canned sweet corn in a per capita amount less than the national figure. In production areas outside of the Midwest, only Maryland and Delaware produced an amount greater than the national level. On the other hand, when Maryland and Delaware are included with the other eastern states, per capita production drops to 2.0 pounds. If it is assumed that per capita consumption is the same throughout the United States, the East becomes an important deficit area.

So little sweet corn is canned in the southern states that no production data are reported for that region. Hence, the South is also a deficit area.

The eight western producing states canned 5.2 pounds per person, 0.2 pounds less than the United States per capita rate. When all western states (Mountain and Pacific states) are included, the per capita production still is high at 4.8 pounds per person. Thus, production in the West would appear to be almost in balance with consumption in the West.

In summary, the major market area for Midwest canned sweet corn would

appear to be eastern and southern states as well as the Midwest itself.

Data on market area furnished by canners and the Wisconsin State Canners Association bear out the above conclusion.[11] Among 22 responding firms canning sweet corn in Minnesota, Iowa, and Illinois, the West North Central states are the primary market for 14 firms and a secondary market for seven others; the East North Central states are the primary market for 14 firms and a secondary market for four others (table 8). The Middle Atlantic and South Central states are primary markets for nine and eight firms, respectively. The major market area for Wisconsin canned sweet corn is in the East North Central region. But all other regions are important markets except the Mountain and Pacific states. The Mountain states are important markets to only four Iowa and Minnesota firms; the Pacific states are not important markets to any of the 22 reporting firms.

Table 8. Importance of market regions* for canned sweet corn, 22 processing firms in Iowa, Minnesota, and Illinois, 1956

Region*	Number of firms indicating region as a major market	Number of firms indicating region as a minor market
New England	3	4
Middle Atlantic	9	3
South Atlantic	5	5
East North Central	14	4
West North Central	14	7
South Central	8	10
Mountain	4	4
Pacific		5
Total responses†	57	42

* *New England States:* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut. *Middle Atlantic States:* New York, New Jersey, Pennsylvania. *South Atlantic States:* Delaware, Maryland, District of Columbia, Virginia, North Carolina, West Virginia, South Carolina, Georgia, Florida. *East North Central:* Ohio, Indiana, Illinois, Michigan, Wisconsin. *West North Central:* Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas. *South Central:* Kentucky, Tennessee, Oklahoma, Alabama, Mississippi, Arkansas, Texas, Louisiana. *Mountain States:* Montana, Idaho, Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada. *Pacific States:* Washington, Oregon, California.

† Some firms list more than one region.

SWEET CORN IN THE MIDWEST FARM ECONOMY

Sweet corn can be, and often is, overlooked in Midwest agriculture. This is easily done where more than 4 billion dollars is received annually from the sale of cash crops alone. But income from sweet corn averaged over 25 million dollars per year during 1954 to 1956, and taken by itself this represents a sizable amount (table 9).

To look at sweet corn in the Midwest farm economy, all commercial vegetables must be considered as well as sweet corn's position in individual states. Annual income from principal commercial vegetables was reported by the U. S. Department of Agriculture to be about 136 million dollars during the 1954 to 1956 period. This is about 3 percent of the annual income from all cash crops sold in the Midwest for the 3 years and indicates that all of the principal vegetables, although important, are minor sources of farm income.

Sweet corn has an important place in Wisconsin and Minnesota in terms of income from a cash crop and vegetable crop; and, in Illinois and Iowa, in terms of commercial vegetables. In Wisconsin, about 5 percent of the income from cash crop sales and about 20 percent of principal vegetables were from sweet corn. In Minnesota, over 1 percent of the income from cash crops and about half the income from principal vegetable sales was from sweet corn. Even with substantial farm sales in Ohio, Indiana, Michigan, and Kansas, sweet corn's relative position is minute.

Sweet corn's position in the farm income picture is quickly understood when number of farms and acreages involved are considered. About 28 thousand of 1.2 million farmers in the *seven* leading sweet corn producing

[11] From a mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa, fall 1956.

Table 9. Cash receipts from farm marketing, sweet corn, commercial vegetables, and all crops, Midwest and United States, 1954-56 average

State	Sweet corn	Principal commercial vegetables	All cash crops
		(1,000 dollars)	
Ohio	2,943	20,835	387,443
Indiana	800*	14,755	376,995
Illinois	5,619	18,921	799,476
Michigan	2,531†	31,610	288,997
Wisconsin	5,999*	27,940	126,484
Minnesota	6,203*	14,817	388,537
Iowa	1,316*	3,294	451 958
Missouri	130†	2,756	335,111
North Dakota	.....	.....	350,862
South Dakota	.....	31	163,597
Nebraska	.....	52	299,268
Kansas	100†	965	409,887
Midwest	25,641	135,976	4,378,615
United States	72,781	1,041,533	13,780,522

* Production for processing only.

† Production for fresh market only.

Source: USDA Statistical Bulletin 210, *Vegetables for Processing...1949-55*, and annual summaries; USDA Statistical Bulletin 212, *Vegetables for Fresh Market...1949-55*, and annual summaries; and *Farm Income Situation*, AMS, USDA.

states grew sweet corn commercially in 1954. In *nine* Midwest states for which acreages are reported, only 0.4 million acres of sweet corn were harvested as compared with 135.5 million total harvested acreage in these nine states. Even in Wisconsin, where concentration is the greatest, only 7.5 thousand of 153.6 thousand farmers grew sweet corn on 1 out of 100 acres. Thus, in the state and the Midwest aggregate picture, sweet corn plays a minor role in the Midwest farm economy. On the other hand, sweet corn production is concentrated in a few counties, and is important to the localized farm economy.

PART II.

THE PROCESSOR IN THE MIDWEST SWEET CORN INDUSTRY

The key position of the processor is described in order to complete the picture of sweet corn in the Midwest setting. This is done by:

1. Describing the Midwest canning firms in terms of number, size, and relative costs in canning sweet corn.

2. Describing the market structure for sweet corn and the processor's position in it.

MIDWEST PROCESSING FIRMS

The basic function of the processor in the sweet corn industry is to acquire a highly perishable commodity on the one hand, process it, and sell a semi-durable commodity on the other. The processor's key role in the industry grows out of two things. First is the interrelationship that exists between two different markets—the one in which he buys the raw product and the one in which he sells the finished product. The second is his *opportunity* to bring his various activities in the two markets into a consistent, harmonious relationship (i.e., integrate the two markets).

Number of Firms

The number of independent firms processing sweet corn is difficult to determine from available sources. Some companies process intermittently. Subsidiary firms are difficult to identify with the parent firms. The best estimate available is that there are 83 independent firms canning sweet corn at 139 plants in 6 major Midwest processing states, as of 1955-56 (table 10). Almost half of the firms pack less than 100,000 cases a year; three-fourths of them pack less than 250,000 cases.

Firms in Ohio, Indiana, and Iowa are typically small ones; those in Wisconsin

Table 10. Approximate number of firms canning sweet corn, by size of firm, select Midwest states, 1955-56*

Size of firm, as indicated by cases of sweet corn canned	Number of firms						
	Ohio†	Indiana†	Illinois‡	Wisconsin§	Minnesota‡	Iowa‡	Total Midwest firms*
Less than 100,000	8	3	1	22	2	5	41
100,000 to 249,999	1	0	1	12	4	3	21
250,000 and over	0	1	2	6	3	1	13
No information	.....	.....	2	.....	.....	2	4
National canners¶	1	1	4	4	4	1	4
Multiplant canner, headquarters in another state	.....	1	.....	.....	1	.....	.....
Total*	10	6	10	44	14	12	83

* Subsidiary firms and the owning canning firm were counted as one firm in the state and Midwest totals.

† From a survey of processors conducted by Ohio State University, January 1956. Size is estimated by averaging the 1954 and 1955 pack.

‡ From a survey of processors conducted by the University of Minnesota, fall 1956. Size is an estimate of the usual pack.

§ From the Wisconsin State Canners Association. Size is estimated by averaging the 1954, 1955, and 1956 pack. Five firms that went out of business between 1954 and 1956 are not included.

¶ Includes Stokely-Van Camp, Inc.; Libby, McNeill and Libby, Inc.; Green Giant Co.; and California Packing Corp.

are small and medium-sized; and those in Illinois and Minnesota are typically medium- and large-sized. Minnesota, with one-third as many canning firms as Wisconsin, usually packs about the same total number of cases.

The small and medium-sized firms pack a smaller proportion of the canned sweet corn. Firms packing less than 100,000 cases accounted for only 10 percent of the sweet corn pack in Minnesota, Wisconsin, Illinois, Indiana, and Ohio in 1954-55 (table 11). Even when firms packing up to 250,000 cases a year are included, only 25 percent of the total is accounted for. The largest share of the sweet corn (75 percent) is canned by about 20 percent of the firms (those packing over 250,000 cases a year).

Table 11. Sweet corn pack by size of firm, Minnesota, Wisconsin, Illinois, Indiana, and Ohio, 1954-55*

Firm size as indicated by cases of sweet corn canned	Actual cases packed	Percent of pack
Less than 100,000	2,345,224	10
100,000 to 249,999	3,242,979	15
250,000 and over	16,611,462	75
Total	22,199,665	100

* From state canners' associations in Illinois, Minnesota, and Wisconsin; and from a survey of processors in Ohio and Indiana conducted by Ohio State University, 1955-56.

Canning Costs

Firms' per unit operating costs can be lessened by processing foods other than sweet corn. And three-fourths of the 83 firms in the six Midwest states did process some other food.[15] This indicates that many a firm's operation would be affected by joint costs. Peas were the most common other food, with over two-thirds of the firms processing peas as well as sweet corn. But the existence of the 14 firms canning only sweet corn, even though they have a production opportunity to process some other food, indicates that spreading costs over several products may not be especially important to sweet corn canning operations.

The canner has many different costs. The raw product is but one, and not the leading one at that (table 12). In 1952 and 1953, the raw product and its acquisition comprised only about a quarter of the total unit cost of a can of labeled sweet corn. The can, the label, and the cases cost more than what was in the can. *The importance of the cost of the raw product lies in its being more flexible than the other major items.* Due to this greater flexibility, any change in the price canners receive for their product *could* be associated with a greater proportionate change in the price paid to farmers for the raw product. That is, a 1-percent change in price received by processors *could* be associated with a greater than 1-percent change in prices paid farmers.[16] Put another way, a 1-percent change in cost of the raw product *would mean* a somewhat less than 1-percent change in the price of finished product.

Firm Market Activities

Major marketing activities of canners in the finished product market were grouped according to three general activities. These are: (1) advertising by canners, (2) controlling quality of pack, and (3) deciding how the finished product is sold—i.e., buyer's label or canner's label.[17] A sale is termed "buyer's label" when the canner sells an unlabeled can of sweet corn and attaches some ulti-

[15] See Appendix table C-1.

[16] R. G. Kline and M. E. Cravens report that a 1-percent change in retail price is associated with a 1.48-percent change in price paid sweet corn growers the following year. (See Kline and Cravens, *op. cit.*, p. 11.)

[17] Based on canners who advertise in various media to promote their products. Canning companies which advertise fall into two groups: first, those advertising on a national scale, including Stokely-Van Camp, Inc., Libby, McNeill and Libby, Inc., Green Giant Co., and California Packing Corp.; second, those advertising on an area or regional scale (as in one city or only in a few cities) as Owatonna Canning Co. or Illinois Canning Co. Advertising allowances to buyers were not considered because they involve some element of price concession.

Table 12. Relative cost of acquiring, processing, and selling canned sweet corn per 24/303 case, 1952, 1953, and 1954

Item	Seven selected plants*		Representative plant†
	1952	1953	1954
	(percent of total cost)		
All labor	13.3	14.5	11.6
Raw product and acquisition costs	27.8	27.2	26.5
Cans and cases	27.9	27.4	30.2
Supplies, power, depreciation	16.0	17.3	16.6
Selling costs	15.0	13.6	15.1
Total	100.0	100.0	100.0
Cost per 24/303 case	$2.73	$2.84	$2.60

* From unpublished data, Farmer Co-operative Service, Fruit and Vegetable Branch, USDA, including five Midwest plants and two Eastern plants.

† From *Price Spreads in the Canning Industry*, Staff Study of Income, Costs and Profits in the Canning Industry, Fiscal Year 1954-55, 84th Congress, 1st Session, Committee Print, Committee on Agriculture and Forestry, 1955.

mate buyer's label to the can. A sale is termed "canner's label" when the canner sells the canned sweet corn with his (the canner's) own label on the can.

These activities were associated with size of firm. Based on replies from 27 Illinois, Iowa, and Minnesota canning firms, the smaller sized firms customarily do not advertise their product, customarily sell predominantly buyer's label, and are not so concerned with packing as high a proportion of "fancy" quality products as the larger firms in the industry.[18] On the other hand, firms canning over 250,000 cases a year customarily sell predominantly canner's label, advertise, and are more concerned with packing a higher proportion of "fancy" quality product. Where these larger firms sell predominantly under their own advertised label, they are more concerned with "quality control."

R. G. Kline and M. E. Cravens, in a study of 32 plants in Ohio, Indiana, and Wisconsin, found that sweet corn processors usually decided the variety of sweet corn planted, the planting date, and the harvest date.[19] In addition, processors, through fieldman contacts, make recommendations as to seeding rates, selection of planting location, and fertilization. Many processors make recommendations about cultivation and weed control. Kelly found a similar pattern in Illinois.[20] If the sweet corn is to be sprayed for insects (European corn borer and ear worm), the processor usually takes the responsibility for doing so.

The bailment contract (providing for canner's ownership of the crop while it is growing) covers a substantial portion of the sweet corn grown for processing by farmers. Only a few canners use this type of contract, but one of the largest canners in the Midwest does.

When processors in Illinois, Minnesota, and Iowa were asked two broad questions about who assumed responsibility of quality control measures, their answers were as shown on page 31.[21]

Thus, processors concern themselves with farmer production of the sweet corn crop during the entire production period. The question, however, is: To what degree do processors differ in their concern for and control over production? Processors' comments to Questions 18 and 19, given on page 31, shed

[18] See Appendix tables C-2, C-3, and C-4.

[19] Kline and Cravens, *op. cit.*, p. 44.

[20] See R. A. Kelly, *Vegetable Canning Industry in Illinois*, Ill. Agr. Expt. Sta. Bul. 612, June 1957.

[21] From a mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa, fall 1956.

Survey question	Processor's response		
	Processor	Grower	Other
18. Who *assumes* the responsibility for quality control measures during the growth and harvest periods while the raw product is still on the grower's farm? Comment	20	6	1 (both)
19. Who *assumes* the responsibility for quality control measures during the harvest and hauling to the factory? Comment	25	2	

Comments on Question 18

Minnesota
1. Crop is under our control from date it is planted.
2. Grower plants and cultivates corn.
3. Field department advises farmer on company practices and farmer must carry these out.

Iowa
1. Under supervision of fieldman.
2. The grower plants and tends the crop but it is harvested when processor decides to do so.

Illinois
1. Each territory has a fieldman to check fields for maturity and insects.
2. We purchase corn suitable for canning over our scale and assist grower in harvesting suitable corn.
3. We purchase corn suitable for canning over our scale. We make every effort to assist grower in harvesting suitable corn.

Comments on Question 19

Minnesota
1. We have absolute control as we harvest all corn.
2. Crop is harvested at the company's discretion.

Iowa
1. Fieldman uses Tenderometer for peas and Stienlite system of moisture test for corn.

Illinois
1. Unless the grower specifically arranges to harvest and/or haul his own crop.
2. Farmer is responsible for harvest and delivery—company furnishes equipment at cost.

considerable light. The degree of responsibility for and control over production appears to be somewhat less in Illinois and Iowa than in Minnesota, as indicated by the comments (which includes all comments volunteered).

The comments to Survey Questions 18 and 19 imply that the amount of control over and the responsibility assumed by the canner for the raw product are related to the size of firm and type of product packed. Firms which pack predominantly the golden whole-kernel style, or large firms, tend to assume more responsibility and exercise more control over production than smaller firms. Minnesota processors pack mostly a golden whole-kernel style (requiring a high quality raw product and more quality control) and are typically among the larger sized. Processors in Iowa and Illinois pack a somewhat smaller portion of their total pack as golden whole-kernel.

An appraisal of the market structures out of which the above interrelationships grow is essential in visualizing the processor position in the industry. The business policies of these procuring firms (i.e., the activities of the processor in acquiring raw product on one hand, and the activities of the processor in selling a processed product on the other) are influenced greatly by the

structural characteristics of the two markets in which he deals, namely, the processor-grower market and the finished product market. Also, the conditions and requirements of the finished-product market impose demands and constraints on the processor-grower market, and conversely.

We therefore find the sweet corn processor sitting astride two very differently structured markets, trying to integrate his activities in each. Since the processor is not a passive unit, but rather an active profit-ruling agency—in some cases a relatively large agency—he seeks to bring raw product acquisition activities into harmony with selling activities and conversely.

STRUCTURE OF THE MARKET AND THE PROCESSOR'S PLACE IN IT

Some researchers have found the general concept of a market, as an area within which price-making forces are at work, to be of little help explaining behavior in some agricultural commodity markets.[22] Similarly, with sweet corn for processing, this general concept is of little help in explaining firm behavior. In particular, how is one to identify a market according to its boundaries, i.e., does the Minnesota farmer-grower of sweet corn for processing sell in the same market with the Indiana farmer-grower? What characteristics modify firms' market behavior? Put another way, why does the processor attempt to exert so much influence in the processor-grower market?

The Unit of Inquiry

Papandreou and Wheeler argue that the boundaries of an area within which firms are subject to common forces of supply and demand can be identified with cross-demand schedules.[23] The cross-demand schedules state the various quantities of the first firm's product demanded at various prices for the product of the second firm.

A firm is not subject to common forces of supply and demand with another firm (or group of firms) if, other things remaining equal, the quantity of the product of one firm does not change with a change in price of the product of the second firm (or group of firms). Any two firms are subject to common forces of supply and demand, if the cross-demand schedules indicate that changes in the price of one firm's product influence the quantity sold of the second firm's product. The two firms sell substitute commodities if the sales of the first firm vary in the same direction with changes in price of the product of the second firm, i.e., the product of the first firm is substituted for the higher priced product of the second firm.

The two firms sell complementary products if the sales of the first firm vary in the opposite direction with changes in prices of the product of the second firm. But the commodity canned sweet corn of one firm would appear to be a substitute, of sorts, for canned sweet corn and numerous vegetables—canned, frozen, or fresh. Thus, it appears justifiable to proceed considering the sweet corn product in a substitute relationship.

Until now firms have been considered as sellers only. The above concept for delineating boundaries can also apply to buyers in terms of cross-supply schedules. Two buyers buy under common forces of supply and demand if the quantity purchased by one firm is affected in the opposite direction by a change in price paid by the second firm.

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[22] See H. C. Evans, *The Nature of Competition Among Apple Processors in the Appalachian Area*, W. Va. Agr. Exp. Sta. Bul 405, June 1957, p. 11; and W. W. Cochrane, "The Market as a Unit of Inquiry in Agricultural Economics Research," *Journal of Farm Economics*, XXXIX, No. 1, February 1957, p. 22.

[23] A. G. Papandreou and J. T. Wheeler, *Competition and Its Regulation* (New York: Prentice-Hall, Inc., 1954), pp. 20-37.

In other words, if the second firm pays a higher price, supplies will be wooed away from the first buyer, reducing the quantity the first firm can purchase—assuming, of course, that the first firm's prices are held constant.

It is obvious that when prices are allowed to vary over wide ranges, cross price-quantity relationships will be obtained among a large number of commodities, if not most commodities, food and nonfood. In order to avoid all-inclusiveness, only the more meaningful parts of the cross-demand and cross-supply curve should be considered.

SUBGROUPS. To obtain more reasonable groupings than those defined by cross-demand and cross-supply schedules, Papandreou and Wheeler form subgroups of firms subject to common forces of supply and demand. To do this, they develop a rigorous concept of an industry.[24] They define the industry as a group of firms among which "technological decisions, market decisions, organization decisions of the firms in question display a *similar structural pattern.*"[25] This is a different concept of an industry than has been previously employed in this study. Elsewhere in this study of sweet corn in the Midwest farm economy, the term "sweet corn industry" is used in an all-inclusive way to include farmers growing sweet corn and processors processing sweet corn.

Papandreou and Wheeler's definition of an industry will be employed for appraising and describing the sweet corn markets.

THE MARKET. A concept of an area of competitive behavior and a concept of a market is developed from the foregoing. Firms are members of the same area of competitive behavior if the cross-demand curve between any pair of firms indicates that the firm's products are substitutes.[26] Firms are members of the same market if (1) the firms are members of the same area of competitive behavior, and (2) they display similar production methods, marketing practices, and business organizations.

The market may include one or more market places where physical and institutional arrangements are in evidence and ownership of goods transferred. Lack of movement of the commodity between market places does not necessarily mean the two market places are in different markets. Two market places are in the same market if, with a variation in price greater than transportation cost between market places, supplies of the commodity will shift from one market place to the other.

MARKET STRUCTURE. A structural element of a market is some characteristic which influences firm market behavior and the performance of the market.[27] This influence is manifested in determining and/or modifying the demand or supply relations.

Different "power relations" between firms exist as the *number of firms* differs in the market. "Power relations" refers to the ability of one firm, through its market practices, to affect another firm selling (or buying) in the same market. A firm may find itself selling (or buying) in a market where the power relation is: (1) unique, (2) atomistic, (3) circular, or (4) dominant.

A firm in a unique power relation is a single seller (or buyer) in the market. The unique firm is a price maker. Competitive pressure on this unique firm comes from some other market, or from facing a unique power arrangement on the other side of the market.

A firm in an atomistic power relation has so many competing firms in the

[24] *Ibid.*, pp. 55-72.

[25] *Ibid.*, pp. 59-60.

[26] This terminology is developed by W. W. Cochrane in "The Market as a Unit of Inquiry in Agricultural Economics Research" (see Cochrane, *op. cit.*). His *area of competitive behavior* is synonymous with Papandreou and Wheeler's *market;* his *market,* with their *industry subgroup.*

[27] This concept of structural elements of a market is also from Cochrane, *op. cit.*

market that it is, through its own policies, unable to affect any other firm selling (or buying) in the market.

A firm sells (or buys) in a circular power relation if it is able to affect the quantity sold of any other firm selling (or buying) in the market by its (the first firm's) activity in the market. If the relation is not reversible, the power relation is dominant, with the first firm the dominant one. But for the firm to be dominant, it must have the power to make its price policies effective.

The bargaining relation in a market between buyer and seller is some combination of these four power relations just discussed. For example, of the 16 different possible relations, the common cases in processor-grower markets are a unique or circular power relation on the buyer side and an atomistic relation on the seller side.

PRODUCT DIFFERENTIATION refers to the degree of substitutability of one firm's product for another firm's product. Any firm that sells a homogeneous product in the same market with other firms will sell for the same price as all other firms, even under circular power relations. The firm's sales would fall severely, if not to zero, if it raised its price above prices received by other firms, because buyers would then shift to a competitor's product. A cut in price on the part of a firm in a circular power relation would invite retaliation from other firms in the market by their cutting prices also.

Differentiated products are not perfect substitutes. In some way, no matter how minute, the products of two firms in the same market may differ. Price differentials can exist in the market, based on differences in the products and buyer attachment to one firm's product. Buyers are not easily wooed from another firm by a price cut, and retaliation on the part of the second firm may be slow or not at all. The degree of substitutability is critical with product differentiation.

The *bulkiness of the product* in relation to weight and *type of product* is very important when approaching the processor-grower market for sweet corn. They should be considered independent structural characteristics. Also, certain *characteristics about the firm* and *activities of the firms* in the market modify the configuration of the supply and/or the demand function and quality these characteristics and activities as structural characteristics.

The Approach to Sweet Corn Markets

The data for determining in a refined way the cross-demand or cross-supply schedule for firms in the sweet corn market do not exist—nor do the data necessary for rigorous description of the way the product is differentiated. But if the obvious is recognized, then there are sufficient data for describing the markets, pointing up the important role played by the processor in Midwest sweet corn production.

Structural Characteristics of the Processor-Grower Market

With the exception of an area near Lake Winnebago, Wisconsin, the typical market situation consists of one, or at most only a very few, sweet corn processors contracting with a large number of possible farmer-growers. Although several processing firms are located fairly close together, the picture of the unique buying firm is not altered appreciably. The reasons are that sweet corn in the raw product stage is bulky, prohibiting its being transported great distances and that processors tend to develop tacit "understandings."

The uniqueness of the processing firm grows out of the bulkiness of the raw product in relation to the price paid growers and the distance between processing plants. A most clear-cut case of a unique processor-buyer is found in western Minnesota. This processor is located about 90 miles from the next nearest canning firm. The spheres of operation of the two plants are at least 30 miles apart. It is doubtful if the market activities of one of the proces-

sors are likely to affect the quantity of sweet corn the other processor can contract. There are a large number of possible growers in the area of competitive behavior from which the unique buyer may obtain the raw product. The bargaining power of any individual grower is practically nil, for the processor is in a position to obtain acreage from one of many possible growers. The market reduces to a unique buyer-purchasing, and an atomistic farmer-grower selling power relation.

The actual number of Midwest processing firms purchasing as unique buyers in a market made up of atomistic sellers would be difficult to ascertain. But the number is believed to be a large percentage of the 83 firms canning sweet corn. The transportation cost of this bulky commodity places the nearer processor in a more favorable position, and plants must be very close to each other before the barrier is reduced to a negligible factor.

The circular power relation on the purchaser side is possible when two or more processing firms are located in a relatively small area. A case in point is found in east central Illinois where two plants are located in town H, another in town M about 6 miles north, and another in town R, about 6 miles south of H. However, even here the bargaining power of a unique buyer may be obtainable through a tacit "understanding."

Tacit "understandings" are of two forms. First, it is "understood" that a processor will not overtly woo regular growers away from some other firm. A farmer growing continuously for one processor is assumed to be an exclusive grower for that firm. No other firm will initiate the contracting procedures with this grower. This tacit understanding is so deep rooted that when a merger of two firms is considered, the "grower base" is an important consideration. Second, tacit understandings are made on a basis of dividing the geographical area. For example, it is "understood" between two firms located in the same town that one will draw most of its production from growers east of a north-south road through town, the other from growers west of this north-south road.

Also, competition among processors in a circular power relation is more likely to take the form of services provided. Clodius, Fienup, and Kristjanson found nonprice services forms of competition in certain areas of dairy product processing in Wisconsin.[28] Evans found a similar pattern in apple product processing in West Virginia.[29] Kline and Cravens, in their study of processor-grower relations, found that "non-price services were slightly greater in areas having more than one plant."[30] Such services include supplying fertilizer at cost, certain pieces of farm machinery, soil testing service, and different methods of harvesting.

In the area near Lake Winnebago, Wisconsin, processing plants are located quite close together, with 10 or 12 per county. Any farmer can contract with several processing firms in the area without encountering appreciable distance barriers. But how many firms are necessary in order that tacit understandings are not made and an atomistic power relation among buyers is found? The respecting of each firm's grower base is still a major factor even in this area, for when firm mergers are considered, the grower base is an important factor in merger negotiations. Tacit understandings, more likely than not, affect market behavior even in this area in such a way that the processor's bargaining position is not greatly jeopardized.

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[28] R. L. Clodius, D. F. Fienup, and R. L. Kristjanson, *Procurement Policies and Practices of a Selected Group of Dairy Processing Firms, Parts 1 and 2*, Wis. Agr. Exp. Sta. Res. Buls 193 and 199, January 1956 and February 1957.

[29] See H. C. Evans, *op. cit.*

[30] Kline and Cravens, *op. cit.*, p. 34.

Also, Kline and Cravens, in their study of grower-processor agreements in Ohio, Indiana, and Wisconsin, including firms located near Lake Winnebago, found that their data "did not support an assumption that the pricing structure was associated with the number of plants in the area."[31] Their findings *tentatively* indicate that even in Wisconsin, with a greater density of processing plants, a circular power relation prevails with the market typified by a few buyers and many sellers. The typical market situation still appears to consist of one firm or a very few firms contracting with a large number of possible farmer-growers.

Fewness of buyers permits the processors to gain some concessions from growers. Several examples will demonstrate this point.

The processor is in a position to exercise some control over *who* grows the sweet corn, especially in recent years when reduction of field corn acreage allotments has freed land for other crops. A processor in this position tries to locate farmer producers in areas that he feels are the most advantageous. When asked the survey question[32]—

> "14d. Since 1950, have you been able to locate your acreage in more desirable areas? Yes___ No___"

Eighteen of the processors said they were successful in doing so, four said they were not successful, two said they had partial success, and three did not reply.

For the grower to take advantage of harvesting and hauling services, he must grow a minimum acreage—usually 10 acres. Among the 27 processors in Illinois, Minnesota, and Iowa who were asked the following survey question[33]—

> "14e. What is the minimum acreage you will contract when your processing company harvests the crop?_____"

Nineteen said their minimum was 10 acres, three said 5, two said 15, and three gave no answer.

Two other conditions imposed by processors were noted in the survey of sweet corn growers conducted in the summer of 1957. First, three plants involving two companies stipulated (not written in the contract) to certain growers that if they wanted to grow sweet corn, they must also grow peas. Although this condition was not imposed on all sweet corn growers producing for these plants, the restriction was placed on all new growers whose land was free of pea root rot disease and in areas where new pea vineries were being installed.

The second condition was the rationing of sweet corn acreage among growers. Among 203 growers interviewed in six leading producing areas in Illinois, Wisconsin, and Minnesota during the summer of 1957, 27 could not contract as large an acreage of sweet corn as they desired. In other words, the processor imposed his decision on the grower and limited the number of acres the individual grower could grow.

The processor power position in buying, operating in the market as one or one of a few buyers, is limited by farmers' ability to grow crops which *to them* are close substitutes for sweet corn. And frequently farmers have good alternatives to sweet corn to weaken processor control, forcing the processor to modify his procurement activities considerably. The substitutes are appraised in a later part of this technical bulletin in terms of number and in terms of how "good" an alternative they are to sweet corn.

PRODUCT HOMOGENEITY. The product (an ear of sweet corn in the husks) in this market, although commonly thought to be homogeneous, in reality is highly heterogeneous.

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[31] *Ibid.*, p. 16.

[32] From a mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa, fall 1956.

[33] *Ibid.*

In the eyes of the processor, the product differs between farms, and action programs are developed in light of this distinction in product. Some processors discriminate price-wise according to yield. Contracting is frequently done according to soil type classification and climatic areas.[34]

The product differs with respect to type as between white and yellow, and varieties of the white and the yellow types. It is not uncommon for a firm to prefer one yellow variety for golden whole-kernel and another yellow variety for the golden cream-style of finished product.

The product differs between processors according to the geographical areas in which they operate. For example, the raw product of a firm in Ohio is somewhat different from the raw product of a firm in the most favorable area of Wisconsin. This difference is manifested in terms of *yield* and *ease in obtaining some desired quality of raw product.* The difference may be so great that one firm has a production limitation as to the type of finished product that can be packed.

TYPE OF PRODUCT. The perishability of sweet corn is a highly important characteristic influencing market behavior. Sweet corn, once harvested, will deteriorate in a day. It will lose quality if allowed to continue to grow in the field. When sweet corn growing in the field is in the desired period of maturation, processors have only one to two days for picking the raw product and canning fancy quality golden whole-kernel sweet corn.[35] The period is a little longer for fancy cream-style. If a field of sweet corn has just passed the period in maturation when fancy quality golden whole-kernel corn can be canned, the processor has the choice of packing a lower quality whole-kernel or some grade of cream-style. Flexibility is gained through style and grade of pack. But style and grade of pack are important to the processor—just how important depends on his *marketing activities on the finished product market.*

Yields—mostly as a result of yearly weather conditions—vary considerably from year to year and thus drastically alter production plans by sheer chance. A processor, in making plans, budgets production in terms of cases of finished product. To move from the budget to acres, it becomes a simple arithmetical calculation of yield times acreage. The problem becomes a question of estimating prospective yields. One reasonably conservative method of estimating yield would be to average yield for the three most recent years. This was done for states in the Midwest and the United States. The results are shown in table 13.

It is readily apparent that yield estimates contain a large percentage of error. They were 20 or more percent off one year out of four in Wisconsin, the state in which yield prediction has been the most reliable. In Indiana, estimates were off 1 year in 2 by 20 percent or more, and in Minnesota almost that often.

In Wisconsin and Iowa the actual yield was within 5 percent of the predicted yield 1 year in 4. The estimate was not as good in the other Midwest states.

It appears that yields are difficult to predict from historical data. Processors, in planning their yearly production, must make this estimation prior to planting time. Therefore, their control over production is greatly weakened by weather conditions through yield variation.

Complicating this picture still more is the fact that the processor plans to operate the plant every day throughout the pack season. To do this, sweet corn in the field must be maturing daily.

[34] See Appendix table C-5.

[35] From a mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa, fall 1956.

Table 13. Yield estimation based on previous three years: Number of years yield estimates would be in error by percent error, select Midwest states and United States, 1918 to 1957

Percent error in yield estimates	States						
	Ohio	Indiana	Illinois	Wisconsin	Minnesota	Iowa	U.S.
	(number of years)						
Tendency to underestimate							
0 to 4.9	5	3	4	4	3	5	4
5 to 9.9	5	4	3	4	2	1	4
10 to 14.9	5	2	5	2	4	4	2
15 to 19.9	3	3	1	2	1	1	5
20 and over	5	9	8	8	10	10	6
Total	23	21	21	20	20	21	21
Tendency to overestimate							
0 to 4.9	1	3	2	7	2	5	4
5 to 9.9	4	2	8	1	4	3	6
10 to 14.9	1	0	2	3	3	2	1
15 to 19.9	0	2	0	3	1	3	3
20 and over	8	9	4	3	7	3	2
Total	14	16	16	17	17	16	16
Total							
0 to 4.9	6	6	6	11	5	10	8
5 to 9.9	9	6	11	5	6	4	10
10 to 14.9	6	2	7	5	7	6	3
15 to 19.9	3	5	1	5	2	4	8
20 and over	13	18	12	11	17	13	8
Total years	37	37	37	37	37	37	37

Source: USDA Statistical Bulletin 132, *Vegetables for Commercial Processing, 1918-50;* USDA Statistical Bulletin 210, *Vegetables for Processing...1949-55;* and *Vegetables—Processing, Annual Summary, 1957,* AMS, USDA.

This is done by means of spaced plantings, and the processor taking over all decisions and responsibilities for harvesting. And to accomplish what can't be done by contracting in the way of spaced plantings, and harvesting in the desired maturation stage, the processor frequently produces the raw product on his own.

THE PROCESSOR AS A PRODUCER. The processor as a producer of the raw product is an important characteristic of the processor-grower market, because this circumstance influences the acreage to be contracted with farmers, the terms of contract, and the contract price. It shifts and modifies the shape of the demand curve confronting farmers for sweet corn for processing.

A hypothetical example will demonstrate this. Suppose a processor is the only buyer in the market, and he wishes to process 6,000 tons of sweet corn. With a 3-ton yield to the acre, he plans to contract 2,000 acres with growers. But at his usual price of 20 dollars per ton he finds that with utmost effort he can contract only 1,800 acres. To contract the additional 200 acres, he estimates that he must pay 25 dollars per ton—and this not only for the 200 acres, but for the full 2,000 acres. He has the alternative of growing the other 200 acres himself, at a cost of 30 dollars a ton. By budgeting he finds that if he contracts the 2,000 acres with farmers at 25 dollars per ton, it will cost him 150,000 dollars. But, contracting the 1,800 acres at 20 dollars a ton and growing the remaining 200 acres on his own, his cost of raw product totals 126,000 dollars. By growing these 200 acres himself, he can save an estimated 24,000 dollars. A 24,000-dollar saving for a medium-sized firm processing from 2,000 acres is a substantial one. The logical behavior for the processor is, therefore, to produce the 200 acres

himself and contract only the 1,800 acres at 20 dollars per ton.

The processor's bargaining position in the processor-grower market is enhanced by his production activities. If the desired acreage cannot be contracted, the processor has the alternative of producing the raw product. The shape of the demand curve for *farmer-grown* sweet corn is thus modified to become more elastic over the "higher" price intervals.

These conclusions are substantiated by the number of canners growing and by their reasons for growing the raw product themselves. Nineteen of 27 firms in Minnesota, Iowa, and Illinois produced from 3 to 50 percent of the raw product themselves. Eleven grew the raw product to obtain some desired quality. Twelve grew the raw product to insure the desired quantity, to even out yearly fluctuations in the acreage that could be contracted at announced prices, and/or to make up a deficit in production. Four canners grew the raw product because they could grow it for less than the cost of contracting with farmers.

NATURE OF FIRM. Given the characteristics of the product, would not processor control over production and concern with it be expected? The processor has the greatest interest at stake. His profits can be materially altered by the type of finished product canned; while the grower's gross returns are altered somewhat less because sweet corn is a minor enterprise, or not altered at all because the price he receives may not be determined by quality characteristics.

Structural Characteristics of the Finished Product Market

The structural characteristics of the finished product markets differ greatly from the processor-grower markets. There are four large sweet corn processing firms selling throughout the United States: they are Stokely-Van Camp, Inc.; Libby, McNeill and Libby, Inc.; California Packing Corp.; and Green Giant Co. There are 10 to 12 large processing firms selling on a regional basis. There are two retail food chain organizations which process sweet corn with their own resources. The remainder, about 60, of the firms are small, and their selling activities difficult to generalize.

A rigorous classification of markets appears necessary for describing processing firms' behavior in the finished product market. Do all 83 Midwest processing firms sell in the same area of competitive behavior? If so, then do they display similar production practices, marketing activities, and business practices? For example, does white whole-kernel sweet corn—"shoepeg" sweet corn—sell in the same market with golden cream-style sweet corn?

Few firms process white whole-kernel, many process golden cream-style. The finished products are different physically. The white whole-kernel type of sweet corn has been produced at a fairly constant total level, while golden cream-style has been produced in increasing amounts over the years. A nonzero cross-elasticity is expected to exist between white whole-kernel and golden cream-style sweet corn. But a nonzero cross-elasticity is also expected to exist between other vegetables (canned peas, for example) and white whole-kernel, as well as between other vegetables and golden cream-style sweet corn. Whether or not white whole-kernel and golden cream-style sweet corn sell in the same market depends on the cross-elasticity over the relevant price range. (Information for making this comparison on a sufficiently refined basis is not available.) The available facts indicate that these two styles of sweet corn are somewhat different commodities which may sell in two different finished product markets.

But many canning firms process all four types of finished products (whole-kernel and cream-style white, and whole-kernel and cream-style golden), and most firms process cream-style

golden or whole-kernel golden.[36] No canners were found to process only the white types. Thus, most firms have a product to be sold in an area of competitive behavior with other canning firms, although more than one area of competitive behavior may be distinguished on the basis of style of pack—i.e., cream-style golden and whole-kernel white.

The value of the canned product in relation to weight is such that it can be shipped fairly long distances.[37] This feature of the canned product places almost any Midwest canning firm in a position to enter the competitive area with any other Midwest canning firm and with many canning firms located in other regions of the United States.

Canning firms display different business organizations and marketing activities. Two cooperative canning firms are included among proprietorships and corporation forms of business organization. Larger firms advertise and sell their product predominantly canner's label. Smaller firms typically do not advertise, and they sell their product buyer's label. It is possible to identify at least two markets from the limited information available—a canner's label market and a buyer's label market—and possibly several others.

The four nationally advertised firms typify the canner's label market.[38] Usually, each firm employs a sales force—placing the firm in direct contact with the retail outlet buyer, institutional buyer, or wholesale buyer. Each firm processes sweet corn in each major sweet corn producing region—East, Midwest, and West. Each displays a multiplant, a multiproduct type of organization. Each advertises its major products on national bases and services a national market. No other sweet corn processing firm displays more than two of these characteristics. These four firms thus appear to sell on a somewhat distinct national canner's label market. In this market, a circular power relation among the four firms would be expected, with nonprice competition substituted for price competition. Price competition among the four would tend to be camouflaged under such things as advertising allowance to buyers.[39]

The four firms selling on the national canner's label market process a major share of the sweet corn processed in Minnesota, Wisconsin, Illinois, Indiana, and Ohio, giving them substantial control over supply, enhancing bargaining power. Available evidence indicates their share to be in excess of 40 percent of the pack in these states.[40] If these firms were of equal size, each would have 10 percent of the market.

The 10 to 12 firms selling canner's label and advertising their labels on a regional or area basis appear to make up a second, but not very distinct, canner's label market. Not one of these firms, taken individually, would appear to be of sufficient size as to affect appreciably the policies of any one of the four firms selling on the national canner's label market. Not one of the

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[36] See Appendix table C-6.

[37] At least two Minnesota processing firms sell the bulk of their product to New York. This indicates that the geographic area in which the finished product can be sold is a large one.

[38] Stokely-Van Camp, Inc.; Libby, McNeill and Libby, Inc.; California Packing Corp.; and Green Giant Co.

[39] Evidence of administered prices in this market and of a circular power relation among these firms was observed by Charles W. Miller and presented by him in *Postwar Price Determination in the Wisconsin Canning Industry, Theory and Practice*, unpublished Ph.D. thesis, University of Minnesota, Minneapolis, p. 56. Miller had access to information unavailable for this work.

[40] The percentage was approximated from the number of plants operated by the larger firms and from the pack of these firms as follows: Of 69 plants operated by firms processing 250,000 and over cases a year, 40 plants or 58 percent were operated by the four firms selling on the national canner's label market. Equal quantities are assumed to be packed at each plant, although these four firms tend to pack more sweet corn at each plant than the other larger processing firms. Where the firms packing 250,000 or more cases account for 75 percent of the total, it follows then that the four nationally advertising firms pack 58 percent of this—or about 44 percent of the total sweet corn packed in 1954-55.

regional firms operates a plant in any other leading production region. Not one advertises on a national basis. Often the services of a food broker are employed in the marketing process. On the average, the regional firms are substantially smaller in size than the "national canners"—packing only 3 percent of the Midwest pack per firm. The regional firms tend to follow the "national canners" in their marketing and pricing practices.[41]

The 60-odd smaller canning firms typically sell on the buyer's label market. The power relation between these firms, in absence of more information on cross-sales schedules, would appear to approach an atomistic relation. The bargaining power of any one of these firms—each with less than one-half of 1 percent of the Midwest pack—would appear to be quite limited in the markets.

There is a strong interrelation between the canner's and buyer's label markets. The national canners sell "second" and "third" brands either as nonadvertised brands or as regionally advertised brands. Every processing firm, large or small, is in a position to sell on the buyer's label market; some larger firms (particularly regional firms) rely on the buyer's label for a substantial portion of their sales.[42] Although the smaller firms are excluded from the canner's label market, they do produce about 25 percent of the total sweet corn canned. Due to the connection between markets, the smaller firms as a group can have an impact on this market.

The firms on the buyer's side of this market make a similar structural picture in regard to number, size of firm, and, possibly, purchase activities. There are a few large buyers such as the large retail food chains. There are many chain store and wholesale buyers that service areas covering only a few states. Then there are smaller buyers, such as small wholesalers, jobbers, and localized retail store chains of two to ten stores. The picture is one of large buyers bargaining with large sellers; and large buyers bargaining with small sellers. The picture also includes large sellers and small sellers competing with large and small sellers.

PRODUCT HOMOGENEITY. All of the large processors try to gain bargaining and competitive advantage through differentiating their product and selling on the canner's label market. They attempt, and succeed reasonably well, to achieve a differentiated product and to fix consumer preferences to their brands of sweet corn through consumer advertising.[43] One firm differentiated ten canned products as between white whole-kernel, white cream-style, golden whole-kernel, golden cream-style on three different quality levels.[44]

Few smaller sweet corn processing firms attempt direct consumer appeal. They are concerned with satisfying their immediate buyers with some quality level for the style of pack involved. Most of their sales are buyer's label sales in which one can of sweet corn often looks very much like another, regardless of who canned it. Although they do not make consumer appeals, firms attempt, with varying degrees of success, to differentiate their product or the services provided, or to modify their product to the desires of their buyer or buyers. Some formally survey their regular buyers prior to production planning to estimate ap-

[41] R. A. Kelly, *Vegetable Canning Industry in Illinois*, Ph.D. thesis, University of Illinois, Urbana, p. 193, observed among Illinois canners, "The general method of pricing appears to be to 'follow the leader' in allowing discounts of 10 to 20 cents a dozen under 'national brand' products." Comments of brokers in Minneapolis and St. Paul, Minnesota, indicate a similar practice followed on the canner's label market involving regional brands in these cities.

[42] From a mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa, fall 1956.

[43] Buyers (retail chain stores in particular) counter with creating and advertising their own labels.

[44] Can size is considered here to be a minor method of product differentiation.

proximate quantities and what styles to be produced.[45] It is not peculiar for the processor to negotiate a preplanting contract with some buyer, stipulating styles, qualities, and quantities to be produced. This is an area in which product differentiation, in accordance with buyer's preference, is found even among the smaller canners.

The canned product is virtually a durable commodity which can be stored for long periods. With so many of the smaller firms located in the Midwest, it follows that some are unsuccessful at product differentiation that is in line with the desires of buyers. Other firms are unsuccessful in differentiating their entire pack. The unsuccessful firm soon finds one (or a very few styles) with which it can compete favorably with other unsuccessful firms, and this is what it cans.

Often the style which such a firm decides upon is golden cream-style sweet corn, for the raw product requirements are relatively not great and there is a large market for it. The quality of the canned product can be altered in processing by: (1) varying the amount of condiment added; (2) changing the texture of the raw product (the process is called creamogenation); and (3) by varying the amount of cornstarch added.[46] Any product differentiation advantage gained by one firm could easily be wiped out by other firms if they altered processing techniques and copied the type of product. Virtually all sweet corn processors are in a position to process this style of sweet corn and most do process it. This means that a fairly large number of firms are in a position to supply a relatively homogeneous product.

At least two distinct and differently structured markets in which Midwest processors sell canned sweet corn can be identified from the foregoing discussion. These are (1) the nationwide canner's label differentiated product market, which includes only four large selling firms; and (2) the buyer's label fairly homogeneous product market, which possibly includes a large number of firms that differ appreciably in size. Although the national canner's label market is more properly classified as an imperfect oligopoly, available data are inadequate for classifying the buyer's label market for the homogeneous product. That a large number of firms are in a position to sell on this buyer's label market would lead one to believe it a purely competitive market. But the presence of large sellers in the market would appear to be sufficient grounds for casting doubt. In spite of this, many firms' market behavior is the same as though it were a purely competitive market. That is, the firm is a price taker.

Two additional markets may possibly be identified as being regional canner's label market and buyer's label differentiated product markets. Distinction between these two would be on the bases of the level in the marketing process for which the product is differentiated, the ultimate consumer or the immediate buyer. If this distinction is not drawn, they would fall into one differentiated product market. The number of firms selling in these markets is not small. The nationally advertising firms sell their second and third brands here. These markets are characterized by a fairly large number of firms selling a differentiated product with each firm acting somewhat independently from others.

MARKET PRICES. It appears that the general level of prices in any given year is determined by the total quantity of all types of sweet corn available and processor expectation about prospective prices, influencing inventory carryover.

[45] From discussions with canners and brokers.

[46] For this reason, a firm processing only golden cream-style sweet corn may not be as concerned with high-quality raw product production as some other firm processing a different finished product.

The prices in different markets are determined by degrees of differentiation; market shares and power relation; point in the marketing channel; and available supplies of the particular product distinguishable by color, cut, quality, and can size. Price differences in a given market on similar items that exist at any point in time reflect differences in bargaining position among operators in the market.[47]

The national canners appear to dominate markets. Many processing firms use prices of nationally advertised brands as a basis of pricing their product. With over 40 percent of the Midwest production and at least over 30 percent of the United States production, the national canners through their sales policies obviously affect prices. No one firm or small group of firms, however, appears to have affected price maintenance in sweet corn markets over a period of years. Retail price expressed in 1947-49 dollars fell from 16.6 cents per 303 can in 1953 to 14.9 cents per 303 can in 1955. (See Appendix table A-1.) Price maintenance over the years was limited by the balance of bargaining power, the large number of firms involved, the attempt to increase market shares, the freedom of entry, and the variation in raw product yield.[48]

Processor's Place in the Market

The processor acquires the raw product in a market where he has considerable control over procurement through his production activities and through his bargaining position as the only one or one of a few processors in the area. On the other side, the processor sells the processed product in a competitive structure where selling advantage comes through differentiating his product and, in some way, creating a demand for it. Rising out of success in creating a demand for a differentiated product, the processor has the sole responsibility for supplying the differentiated product in the quantities demanded. This becomes a rigid commitment for the processing firm, and the firm must be in a position to supply this demand at all times or risk losing its selling advantage. There are always several other processing firms competing for selling advantage. Firms selling in this position would logically organize their activities in such a way as to protect their selling advantage, insofar as possible, and would plan to procure a raw product in line with the finished product sold.

Firms unsuccessful at differentiating their product are in another situation. They have no commitment as to the type of finished product sold. Their main advantage is in selling at as low a price as some other firm that has had only partial success at differentiating the product. Firms in this position would organize their selling and producing activities in such a way as to compete favorably with other firms selling a similar product.

Whether successful or unsuccessful at differentiating the product (or prod-

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[47] An instance where a small canner was in a favorable bargaining position and one where a small canner was in a weak bargaining position that were related to the author will emphasize the importance of bargaining position. In the first case, a large canner supplying a differentiated market ran short of supplies, and yearly supplies of the canned product were short. This large canner approached one of the smaller canners for a specific grade and type of pack to supply the demand for the differentiated product. The smaller canner knew supplies of this particular type were short, and taking advantage of his position, secured a price for a shipment higher than the product's per unit retail value. In the second case, a large canner supplying a differentiated market again ran short of supplies and approached a small canner for supplies, but in this case the small canner was able to secure price equal to that of an alternative sale. A unit of the small quantity this canner sold under his own canner's label retailed for 2 cents less, side by side with a second can of his corn with the larger canner's label on it.

Factory list prices are often a point of departure in the bargaining process. The prime example of price concession in the bargaining process among large operators is price concession via an advertising allowance to the buyer.

[48] "Freedom of entry" refers to the ability of a firm to introduce a canned sweet corn product on some market. Entry into the buyer's label market appears to be relatively easy for a number of canning firms not now processing sweet corn.

ucts), the processing firm has the task of orienting raw product procurement in line with finished product selling activities.

From formal surveys of buyers as to their prospective purchases, and estimates of prospective sales as based on past sales records, the processor determines the quantities he desires to can of each style of sweet corn by grade for the forthcoming pack year. These estimates are then interpreted in terms of tons of raw product and then in terms of acreage to be contracted with farmers or grown by the firm. Merely contracting the acreage with farmers does not insure the canning of the desired quantity, type, or quality of sweet corn.

Yield, where it tends to vary considerably, can easily change the market picture for the firm, particularly the firm supplying a differentiated product. Low yields bring with them the danger of an insufficient quantity to meet the demand for the differentiated product and, with that, the loss of selling advantage. On the other hand, high yield means more than enough supply to meet this demand. Excess supplies are not so serious, because the product can be stored or sold as a nondifferentiated buyer's label product. But selling buyer's label, thereby increasing supply of this type of product, would result in lower prices with possible repercussions on the differentiated product sales, as well as adverse effects to the firms who sell their entire output buyer's label.

Sweet corn grown for processing is typically a minor enterprise on Midwest farms. Due to this position in the farm organization, the sweet corn enterprise may not command the specialized attention required to produce a certain type of raw product as measured in terms of variety, maturation, uniformity, and "quality."

The processor, in his efforts to obtain some specific quantity of a specific finished product, integrates production and processing into virtually one decision-making unit. He makes most of the decisions affecting the flavor, color, texture, appearance, and quantity of the finished product.

The processor thus integrates the activities of two markets. Since his power position in the market is greater vis-à-vis producers than with buyers of the finished products, he attempts to make his more important adjustments in the processor-grower market. Here he effects quantity and quality changes over raw product (in year-to-year production decisions) to fit the demands and requirements of his finished product market.

It does not necessarily follow that excess profits grow out of the canner's position as a unique buyer in the processor-grower market.[49] Such profits would tend to be bid away in the finished product market, with some processors finding themselves in a cost price squeeze between (1) high raw product cost due to the competitive position of sweet corn with alternative crops among growers, and (2) low finished product prices due to little bargaining power in the finished product market.[50] However, processors are in a positon to, and do, capture economic surplus from farmer-growers by producing the raw product themselves. Viewed in comparison with the theoretical perfectly competitive market, the $24,000 "saving" in the example discussed above under the section entitled "The Processor as a Producer of the Raw Product" is economic surplus captured from farmer-growers. Nor does it follow that competition is in-

[49] Excess profits, as used here, refer to returns in excess of both fixed and variable costs of production, including a "normal" return for risk bearing.

[50] Excess profits do not exist when the processor produces at the point where average per unit cost of output equals the per unit price received. For an economist who argues such a solution for producers supplying the differentiated product, see E. H Chamberlain, *The Theory of Monopolistic Competition* (6th ed.; Cambridge: Harvard University Press, 1950), pp. 74-77.

effective in bringing about changes within the industry. The shifts in production and in producing area, noted in Part I, indicate the extent to which shifts occurred.

This does not preclude the possibility of canners capturing excess profits. Previously, it was implied that more of the product sold as a differentiated product. Few commodities can be differentiated in so many ways—or lend themselves so well to discrimination in both the raw-product and finished-product market as what we have included under the heading of "canned sweet corn." And the canner can easily be visualized in an excess profit position because of his position of buying and selling in imperfect markets.

The existence of excess profits arising out of the market structure is neither attested nor contested.[51] The important things to note here are:

(1) The canner, large or small, is in a position to effect price and quantity changes in the processor-grower market and, if large, is in a position to influence prices and quantities in his finished product markets, thereby enabling many canners to protect operating margins.

(2) Farmer-growers taken individually do not have the power to affect price and quantity, nor the power to bargain for profits which can grow out of the market's imperfections.

(3) The more important competitive forces modifying canner's prices and profits are found in the finished product market.

THE PROCESSOR'S POSITION IN PROSPECTIVE DEVELOPMENTS

Processors will play the more important part in prospective developments because of the extensive control they have over production. They will usher in most of the technological improvements.

The amount of processor control over and the concern with production tends to vary among Midwest states, depending on type of finished product canned and typical firm size in the state. Processor control tends to be greatest in Minnesota, followed by Wisconsin, Illinois, Iowa, Indiana, and Ohio.

By nature of the market structure, the processor's concern over the raw product will tend to be an integrated part of the sweet corn industry.

The highest price farmers can expect from sweet corn for processing tends to be determined by the cost to the processors of producing the raw product themselves. The lowest price at which processors can expect to obtain grower production is determined by crop alternatives. Between these limits the farm price *can* vary with the price of the canner's product in a percentage ratio greater than one to one.

In appraising the prospective output of sweet corn for processing, processor control over production and the processor who produces the raw product must be explicitly considered. Decisions on quantity and quality of the finished product—those which are made—are usually made by the processor.

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[51] Investigating this aspect as well as overall market efficiency is beyond the scope of this study. However, the number of firms closing out sweet corn operations, as such, is a poor indicator of absence of profits among canners. Growing out of the imperfection in the markets, one group of processors may be capturing excess profits while another is suffering losses.

PART III.

POTENTIAL CONSUMPTION FOR PROCESSED SWEET CORN

THE DEVELOPMENT of the Midwest sweet corn industry can be appraised only in terms of the overall demand potential. The approach to this overall demand potential is through those forces influencing quantities purchased.

The potential consumption for processed sweet corn is projected here within the framework of demand analysis. The order of presentation is first, a discussion of the determinants of an expanding demand for sweet corn; and second, a presentation of the market potential.

DETERMINANTS OF AN EXPANDING DEMAND FOR SWEET CORN

Demand is the relationship between quantities demanded and prices, when other factors remain constant. But these other factors—including population, income, tastes and preferences, and prices of substitute commodities—do not remain constant over time; they play a most important role in market disappearance of processed sweet corn.

Price of Canned Sweet Corn

Any estimate of the potential market must determine or take as given a relative price of sweet corn. Numerous forces, both on the demand side of the market and on the supply side, are at work determining market prices. Earlier yield was seen to vary considerably from year to year; and inventory of carryover stocks was observed to accumulate and then decline in a 5- to 7-year cyclical fashion. Both of these phenomena modify yearly prices. In view of the many unpredictable disturbances that may cause variation in year-to-year prices of canned sweet corn, projecting consumption in terms of a price reflecting "normal" conditions appears preferable to projecting it in terms of predicted prevailing prices.

The "normal" price assumed is the average of annual prices at retail (in real dollars) for the years 1948 through 1955. This price reflects the effects of the technologies developed in recent years that reduced costs and shifted supply. The size of yearly variations in total pack indicates canning capacity available for increased output, even at prevailing prices. Producers in the post-World War II period appear to have adjusted to an increasing demand, and to be in position to supply their services for further increases at approximately the average of prices prevailing during the years 1948 through 1955.

Income

A detailed view of income-consumption relationships is found in cross-sectional consumption studies. Data assembled in the 1955 USDA Household Food Consumption Survey indicate that the relationship between canned sweet corn consumption and income is positive up to the 950 dollars per capita family income level, and negative beyond this level (figure 16). If it is assumed that a family acquires the consumption habits of a higher income group after achieving an increase in income, a proportionate percentage increase in income at all income levels *could* result in no change in consumption of canned

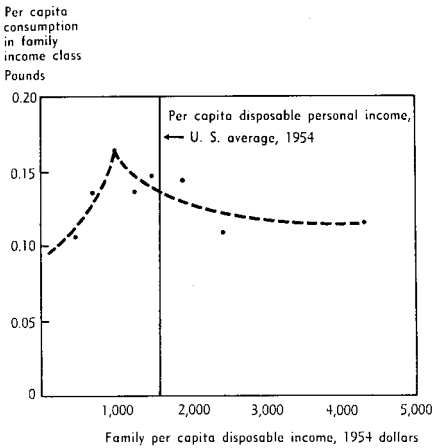

Fig. 16. Per capita consumption of canned sweet corn in one week, by income class, United States, April-June 1955.

(Source: *Household Food Consumption Survey, 1955*, Report No. 1, ARS-AMS, USDA.)

sweet corn—i.e., decreases in consumption at high income levels could offset increases in consumption at lower income levels.

A similar pattern is found in other cross-sectional food consumption studies.[52] These data indicate that per capita sweet corn consumption could increase, decrease, or hold steady with rising incomes, depending upon distribution of the income changes.

Changes in income distributions as they occur over time are associated with changes in real income, and their effects on consumption are incorporated in estimates of income-consumption relationships developed from time-series data. As long as the change in income distribution associated with change in income follows the same pattern over the prediction period as it did over the estimation period, then a projection based on time series should provide a reasonable estimate of prospective consumption.

The consumption of canned sweet corn and real income over time are related in a postive direction. The correlation coefficient between per capita disappearance and real income for the years 1925 through 1941, and 1948 through 1955, is +.8759.[53] The net effect of income on consumption of canned sweet corn in quantitative terms—that is, the effect of change in real income on consumption when other factors[54] are held constant—is, however, the effect that has meaning in a market potential projection. An analysis employing first differences of logarithms indicates that the net effect was +.56—meaning that quantity taken increased about one-half of 1 percent with a 1 percent increase in income—during the periods 1925 to 1941 and 1948 to 1955 inclusive.[55]

Tastes and Preferences

Tastes and preferences are known to vary among age groups, sex, ethnic groups, and geographical areas. Tastes for canned sweet corn are geographically distributed, as indicated by the fact that consumption of canned corn is almost wholly confined to the North American continent. Here, some change in tastes appears to have occurred—as indicated by a change in marketings of canned sweet corn. Elsewhere in this study, a drop in white cream-style and a rapid rise in golden whole-kernel marketings were described. But this says nothing about the demand for all canned sweet corn.

In the theory of demand, tastes are assumed given, determined exogenous to the analysis, and are believed to

[52] See *Family Food Consumption in the United States, Spring 1942*, USDA Misc. Pub. 550, 1944; and *Food Consumption of Urban Families in the United States, Spring 1948*, USDA Agr. Inf. Bul. 132, October 1954.

[53] Actual per capita disposable income divided by Consumer Price Index.

[54] Other factors include the price of sweet corn, population, tastes and preferences, and the effects of price and quantities of other commodities on sweet corn consumption.

[55] See Appendix A.

change slowly over time. In demand estimation, some technique is often employed to account for the effect of these changes on demand. But there is little basis for anticipating prospective changes. For this reason, tastes are assumed to remain constant in the projection developed here.

Population

The relationship between number of people in a market and amount demanded is assumed to be a one to one relation. When population in a market area increases by one more person, total consumption increases by one times the average consumption.

Because consumption of canned sweet corn is confined to the North American continent, the overall market area is essentially the continental United States. Canada is a major sweet corn consumption area, but domestic production about equals quantities demanded.

Although military and institutional per capita consumption differs from civilian per capita consumption, military personnel and institutional population make up a relatively small proportion of the total population, and the difference in per capita consumption is likely small. Therefore, military and institutional consumption are considered to be the same as civilian consumption.

The Bureau of Census population projection, as shown in table 14, indicates a substantial population increase to expand the market potential. The high estimate of population growth, the AA series, is based on the assumption that the 1954-55 fertility level will continue through 1975. The low estimate of population growth, the C series, is based on the assumption that the 1950-53 fertility level will decline from 1953 to about the prewar level by 1975.

Substitute Commodities and Technological Development

In a perfectly competitive world we would be concerned with only the prices of substitutes for canned sweet corn. But in our real world, spiced with new and differentiated products and rapid technological advance in all food commodities, both price competition and product competition from other commodities are important determinants of demand for canned sweet corn. A change in the technology involving canned sweet corn or one of its substitutes could easily alter the competitive position.

Substitute products for canned sweet corn are considered to be frozen sweet corn, fresh market sweet corn, other canned vegetables, other frozen vegetables, and other fresh market vegetables—i.e., essentially the vegetable bundle. It was shown earlier in Part I that production of canned sweet corn was a relatively constant proportion of all canned vegetable production for an extensive period. This indicates that

Table 14. Projections of the total population including armed forces overseas, 1960 to 1975, with estimate for 1955, United States*

Year	Estimate of actual population	Population projection		
		AA	A	C
1955	165,271			
1960		179,353	177,840	176,452
1965		193,346	190,296	186,291
1970		209,380	204,620	196,370
1975		228,463	221,522	206,907

* As of July 1. Series AA, A, and C imply the following assumptions as to fertility: AA.—1954-55 level continues to 1975. A.—1950-53 level continues to 1975. C.—1950-53 level declines from 1953 to about the "prewar" level by 1975.

Source: Statistical Abstract of the United States, 1957, Bureau of Census, USDC,table 3, p. 6.

people tend to consume a fairly constant amount of canned sweet corn relative to consumption of other canned vegetables. Also, technological development affecting canning would tend to affect all vegetables in the same way. Therefore, the competitive position of canned sweet corn with other canned vegetables would appear to be similar in the future as in the past. This assumption is extended to cover the sweet corn aggregate compared with all other vegetables. That is, technological development will affect the sweet corn aggregate in the same way as it does all vegetables, not giving some other vegetable a price or quality advantage over sweet corn, causing a drastic fall or rise in demand for all sweet corn.

The problem now becomes one of viewing the effect of technological change on the relative competitive position between fresh market, frozen, and canned sweet corn. If canned sweet corn, fresh market sweet corn, and frozen sweet corn were competing products, then a change in the quantity disappearance of fresh market or frozen sweet corn should be negatively associated with a change in quantity disappearance of canned sweet corn. Unfortunately, available data are insufficient either to verify or to disprove that such a relationship exists. However, coefficients of correlation between changes in consumption of canned sweet corn and changes in consumption of fresh market and frozen sweet corn (first differences) were computed from the Agricultural Marketing Service's estimates of per capita consumption, on a farm-weight basis, for the years 1937-41 and 1948-55. The results are shown in table 15. No gross r is significant at the 5 percent level. Extending the observation between canned sweet corn and fresh market sweet corn to cover the period 1929 to 1941 and 1948 to 1955, the coefficient of correlation is +.07—again not significant at the 5 percent level.

Table 15. Relationship of a change in disappearance of sweet corn (gross r) as between types, United States, 1937-41 and 1948-55

Change	Change in Canned	Change in Fresh market	Change in Frozen
	(coefficient of correlation)*		
Canned	1	+ .56	— .35
Fresh market		1	— .13
Frozen			1

* No gross r is significant at the 5 percent level.

Thus, we cannot say from *available* historical evidence that year-to-year changes in fresh market or frozen sweet corn consumption occurred at the expense of canned sweet corn. The underlying reasons for this may be any one or any combination of the following: (1) the substantial rise in real income increased demand for all sweet corn in such a way that a substitution effect is obscured; (2) rapid technological advance in all types of sweet corn obscured a possible substitution effect; (3) these different types of sweet corn are poor substitutes; or (4) data are inadequate for a proper test.

Canned sweet corn is in a more favorable position with respect to quality control than fresh market or frozen sweet corn in today's picture (1956-58). Quality factors plague fresh market and frozen sweet corn marketings. Proper precooling and icing maintain quality and prolong "fresh picked" quality characteristics of fresh market sweet corn.[50] However, except for long distance shipment, fresh market sweet corn is often not refrigerated properly and quality is lost in the marketing process. The technology is available but not used. The serious problem which plagues packers of frozen corn on the cob involves blanching, stopping enzyme action in the cob, taste, and texture of kernel. A blanching period long

[50] See J. D. Winter, R. E. Nylund, R. W. Cox, and J. S. Vandemark, *Marketing Fresh Sweet Corn in the Midwest*, Minn. Agr. Exp. Sta. Bul. 427, June 1954 (N. C. Reg. Pub. 45).

enough to stop enzyme action in the cob and to protect taste in the kernel alters the texture of the kernel to a state softer than is desirable. On the other hand, the "high-temperature quick cook" process for preserving canned sweet corn, currently in operation, provides a satisfactory means of maintaining quality until the product reaches the consumer.

Competition in technological advance is being met by and for canners with experimentation on boilable polyester bags[57] and aluminum cans.[58] If successful, these developments can be expected to place canned sweet corn in a more favorable price position by reducing the costs of packaging.

Technological development in frozen sweet corn may not be a serious threat to the Midwest sweet corn canners because, with some additional capital outlay, they can convert from canning operations to freezing operations, or to some combination of the two. Their capital requirement would be less than that of a new firm equipping a plant from the basic huskers and sorting lines to freezing equipment. In this light, the problem then is one of processed versus fresh market sweet corn. Improved freezing techniques may only mean that some processors will change to freezing.

A major threat to processed sweet corn lies in irradiation of foods and the avenue irradiated foods follow.

B. H. Morgan, of the Quartermaster Food and Container Institute, Chicago, says that foods sterilized by radiation will first go into cans or some new type of container.[59] This is somewhat in line with the belief that irradiation will be supplementary to other forms of processing. However, Morgan also indicated that irradiation may be useful in fresh market production when the produce must be shipped some distance—particularly if shelf life can be maintained and extended a few days. Morgan's first statement is to the benefit of sweet corn processing, but his second statement is to the benefit of fresh market production.

If irradiation reaches widespread use in fresh market sweet corn production and fresh picked quality is maintained through to the consumer, people may shift to fresh market sweet corn at the expense of processed sweet corn. On the other hand, if irradiation considerably improves processed sweet corn and does little for fresh market sweet corn then processed sweet corn will be in the more favorable position.

MARKET POTENTIALS, 1960-75

Projecting canned sweet corn consumption as an expected trend appears to be a plausible course of action.[60] Predicting actual consumption in some future year is impossible, because of the number and the nature of economic forces at work determining yearly consumption and to pure chance disturbances.

The potential consumption of canned sweet corn is projected in two models, differing with respect to assumptions about changes in real income. Per capita disposable real income in Model I is assumed to increase by the same annual increment throughout the projection period as it did during the pe-

[57] "Developments to Watch" Department, *Food Engineering*, XXIX, No. 9, September 1957, p. 17.

[58] *Ibid.*, XXIX, No. 6, June 1957, p. 17.

[59] "Experts Eagle-Eye Status and Future of 5 Food Preservation Techniques," *Food Engineering*, XXIX, No. 5, May 1957, p. 109.

[60] Concerning long-run projections for agricultural products, R. F. Daly says: "It should be realized that such projections are not forecasts. They are based on specific assumptions as to growth in population . . . Despite the fact that such projections are bound by the assumptions under which they are made, they highlight the underlying trends." (See R. F. Daly, "The Long Run Demand for Farm Products," *Agricultural Economics Research*, VIII, No. 3, July 1956, p. 74.)

Table 16. Indexes of per capita income, per capita disappearance, price of canned sweet corn, population, and total disappearance 1948 to 1955, with projection for 1960 to 1975, United States. (1955 = 100)

Projection model, year	Per capita income (1947-49 dollars)	Per capita disappearance	Price of canned sweet corn at retail (1947-49 dollars)	Population (projection by fertility rate)		Total disappearance (projection by fertility rate)	
				AA	C	AA	C
			(percent of 1955)				
1948-55	93	95	108	94		90	
1955	100	100	100	100		100	
Model I*							
1960	108	103	108	108	107	111	110
1965	116	108	108	117	113	125	121
1970	125	112	108	127	119	141	133
1975	134	116	108	138	125	160	145
Model II*							
1960	104	102	108	108	107	110	108
1965	104	102	108	117	113	118	114
1970	104	102	108	127	119	128	120
1975	104	102	108	138	125	140	127

* Models differ as to assumption on how income will increase.

riod 1948 through 1955.[61] Per capita disposal real income in Model II is assumed to increase to $1,500 by 1960 and to remain at this level throughout the remainder of the projection.

Per capita consumption is projected from the mean consumption for the years 1948 through 1955. Total consumption is obtained by multiplying per capita consumption by population.

Two other assumptions are implicitly made by choice of models. First, that no major war will break out over the projection period; and second, that no major depression comparable to that of the 1930's will occur during the projection period.

Projection Model I

Per capita canned sweet corn consumption would rise 8 percent by 1965 and 16 percent by 1975 above the 1955 level, given the assumption of Model I (table 16). That is: (1) if real per capita income increases in the same manner between 1955 and 1975 as it did between 1948 and 1955; (2) if the income consumption relationship remains the same as the average for the last three decades (except World War II years); and (3) if the average of the 1948 to 1955 prices is indicative of prospective prices, then per capita consumption would increase 8 percent by 1965 and 16 percent by 1975. With population increases, *total* consumption (as measured by disappearance at retail) would rise 21 to 25 percent by 1965, and 45 to 60 percent by 1975, over the 1955 level.

This projection, as shown graphically in figure 17, appears to be an optimistic prospect for canned sweet corn. It closely approximates a linear extrapolation of domestic disappearance of canned sweet corn for the period 1950 to 1955, a period of rapid growth in in-

[61] The income trend equation developed was $Y = 1.216 + 24.82X$; where Y = real per capita disposable income adjusted to the 1947-49 base year period and X = years with 1947 as year zero. Although more recent information is available on income, most of the data analyzed for the projection are available only through 1955. In order to be consistent, only data through 1955 are included. For comparison purposes, the calculated 1957 per capita real disposable income, employing this formula, was estimated to be $1,464. Based on data presented in the June 1958 issue of *Economic Indicators*, per capita real disposable income in 1957 was $1,461.

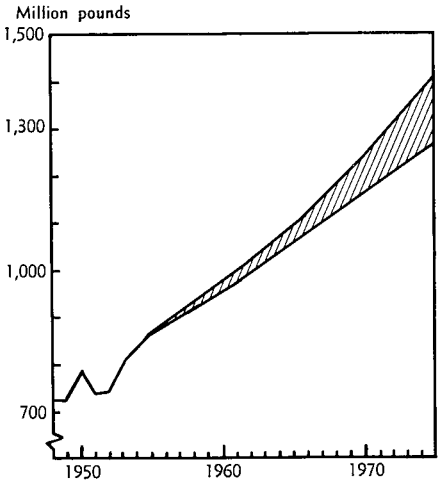

Fig. 17. Model I. Total domestic consumption of canned sweet corn in the United States, 1948 to 1955, with projection to 1975. (Income assumption: linear trend in real disposable income from 1948 through 1955 continuous through 1975.)

come and population. The income-consumption relationship is estimated from a time period when relatively low real income prevailed much of the time. It is employed to project consumption under conditions of high and rising real income. Changes in income distribution associated with a rise in real income over the period covered in the projection are implicitly assumed to be the same as over the time period considered in obtaining the estimate of the income-consumption relationship. In view of the income-consumption relationship found in cross-sectional studies, the estimate from time series may overestimate per capita consumption at high-income levels.

Evidence supporting the Model I projection is found in historical consumption data. Per capita consumption reached an all-time high of 6.3 pounds in 1946, or 0.2 pounds more than the projected 6.13 pounds in 1975 (table 17).[62] But food consumption in the aggregate, as measured in terms of the index of per capita food consumption, reached an all-time high under the conditions of 1946.

Projection Model II

Per capita canned sweet corn consumption would rise 2 percent above the 1955 level by 1960 and remain there throughout the remainder of the projection, under the assumptions of Model II (table 16). Total consumption (disappearance at retail) would rise 14 to 18 percent by 1965, and 27 to 40 percent by 1975, above the 1955 level. The assumptions upon which this projection are based are: (1) per capita income increases to 1,500 dollars by 1960 and

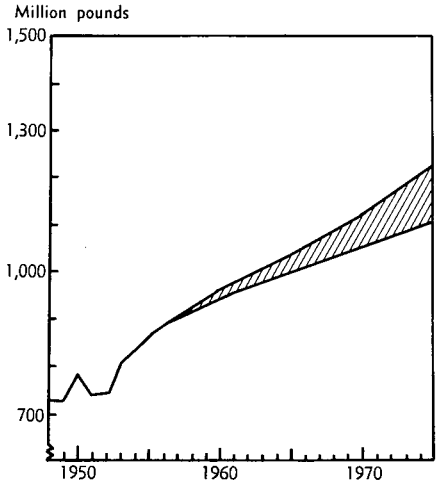

Fig. 18. Model II. Total domestic consumption of canned sweet corn in the United States, 1948 to 1955, with projection to 1975. (Income assumption: real disposable income increases to $1,500 by 1960 and remains at that level through 1975.)

[62] *Supplement for 1956 to Consumption of Food in the United States, 1909-52*, Agr. Handbook 62, AMS, USDA, September 1957.

Table 17. Projection of disappearance of canned sweet corn in the United States, 1960-75

Projection model, year	Estimated per capita income	Estimated per capita disappearance	Estimated total disappearance according to fertility rate	
			AA	C
	(1947-49 dollars)	*(pounds)*	*(million pounds)*	
Model I*				
1960	1,539	5.43	974	958
1965	1,663	5.67	1,096	1,056
1970	1,787	5.90	1,235	1,159
1975	1,911	6.13	1,400	1,268
Model II*				
1960	1,500	5.35	960	944
1965	1,500	5.35	1,034	997
1970	1,500	5.35	1,120	1,051
1975	1,500	5.35	1,222	1,107

*Models differ as to assumption on how income will increase.

remains at this level throughout the projection period; (2) the income relationship remains the same as the average for the last three decades (except World War II years); and (3) the average of the 1948 to 1955 price is indicative of prospective prices.

The Model II projection, shown graphically in figure 18, is slightly less than a linear projection of the 1948-55 total domestic disappearance.

Discussion of Projections

Total canned sweet corn consumption is projected in Model I on two assumptions. First, that the per capita consumption of sweet corn increases 0.56 percent, with a 1 percent increase in per capita disposable income. And second, that population increases in the manner described in table 14. But in Model II, the total consumption is projected almost wholly in terms of increases in population. Both projections are bounded by rigid assumptions concerning prices of the finished product, competing commodities, and national emergencies.

Granted the assumptions, Model I would seem to yield the most favorable, yet realistic potential; Model II would seem to establish the floor. The income-consumption picture found in cross-sectional studies indicates that the income-consumption relationship estimated from time-series data will probably decline over the years and thus bring about some divergence from the Model I projection, even though the other assumptions are met. But there are no means of estimating this change and making the appropriate adjustments in the projection.

PART IV.

THE MIDWEST'S SHARE IN PROSPECTIVE DEMAND

HOW THE MIDWEST will share in the prospective demand for sweet corn depends upon (1) the production response by Midwest sweet corn growers and the processor's raw product procurement activities, and (2) the competition with other major sweet corn producing regions.[63]

The appraisal of the Midwest's share in prospective demand is presented in two sections. Section I deals with the farmer-grower production response and the influence of processors' procurement activities. In Section II, competition among major production regions (interregional competition) is discussed, and estimates of the Midwest's share of the prospective demand are developed.

Section I. Production Response

POTENTIAL production of sweet corn in the Midwest is appraised in terms of the elasticity of supply, the more important forces positioning and shifting supply, and the influence of processors' procurement activities.

Elasticity of supply is a means of expressing the responsiveness of output to a price change when all other influencing factors remain constant. For example, an elasticity of supply of +2.0, or a 1-percent change in price associated with a 2-percent change in quantity offered, indicates that output could be increased greatly with but a small change in price. An elasticity of supply of +0.1 means that very little change in output is associated with a change in price.

Supply is the relationship which describes how quantities offered for sale vary as prices vary when other influencing forces remain constant. These other influencing forces position the supply relation and cause variations in quantities supplied at some given price, i.e., a change in one of these forces causes an increase or decrease in production at some given price. The more important forces positioning and shifting the supply relation are number and prices of crop alternatives; decisions by the government; improved technologies, as reflected in crop yield and cost reduction; and processor procurement activities. Describing the farm supply structure is a point of departure.

[63] The term production response is used to include variation in sweet corn output resulting from movement along the supply curve and to include variation in sweet corn output resulting from the shifts of the supply curve. Where there are several concepts of supply relations, clarification of the concept employed is necessary. Quantities farmers plan to produce at varying prices are the only quantities relevant to the analysis. Some other description of variation in quantities associated with variation in price would be of little value in describing prospective sweet corn production. The concept of the supply relation employed here states the relationship between quantities farmers plan to produce as prices vary and is a reversible relationship. This concept is defined by W. W. Cochrane as a "schedule of intention to produce." See W. W. Cochrane, *Farm Prices, Myth and Reality* (Minneapolis: University of Minnesota Press, 1958), p. 63.

FARM SUPPLY STRUCTURE

Data on sweet corn production were collected in a survey of growers in six leading Midwest sweet corn producing areas. These include east central Illinois (Iroquois and Vermillion Counties); northern Illinois (including five counties in the northern tiers); Columbia County, Wisconsin (close to the center of the major production region in Wisconsin); Sibley and Faribault Counties in Minnesota; and nine counties in southeastern Minnesota. From 31 to 37 randomly selected sweet corn growers were interviewed in each of the six areas.[64]

The Farm Growing Sweet Corn

Farm organizations are described in terms of average acreage and average animal units per farm in table 18. Farms in east central Illinois are organized principally as cash crop farms, livestock being of minor importance. Farms in Columbia County, Wisconsin, are principally livestock farms emphasizing dairy cattle. Feeder cattle and hogs provide an outlet for home-grown grain. No particular type predominates among farms in Minnesota. Farms in northern Illinois are organized in such a way as to resemble a mixture between farms in east central Illinois and Columbia County, Wisconsin.

Although sweet corn is not grown on the "typical" Midwest farm, the surveyed farms appear typical of most farms on which sweet corn is grown. The farms in east central Illinois seem to be roughly typical of sweet corn producing farms in Indiana and Ohio.[65] The farms on which sweet corn is grown in Iowa are poorly typified by Faribault County, Minnesota. However, because only leading producing areas were sampled, statistical inferences are applicable only in the surveyed areas. In attempts to combine sample areas, statistically significant differences between areas were encountered, even between areas in Minnesota.

Production Alternatives

In the broad meaning of the term, an alternative is some activity other than the one with which we are primarily concerned, and this activity may be either more or less favorable than the one which is of primary interest. An alternative to a sweet corn enterprise is some other crop, and the alternative may be more profitable, less profitable, or equally profitable.

Important crop alternatives to sweet corn include field corn, soybeans, small grains, and peas. But identification of the alternative crops is useless unless relative profitability of the alternative is also known.

Relative Per Acre Returns. Information on the relative profitability of the sweet corn and other enterprises under 1956 conditions is presented in table 19 and, under what farmers felt to be usual conditions, in table 20. "Usual" conditions are included in order to extend the observation beyond one year. "Usual" conditions are based on farmers' opinions as to usual yield and state average price for the years 1954 to 1956. In view of price programs, unequal increase in yield per acre, and the introduction and expansion of soybeans as a possible alternative, this period appears best suited for obtaining price ratios.

The information presented in tables 19 and 20 approximates *average* opportunity cost per acre of producing sweet corn.[66] The cost of labor (family and hired), custom work, equipment (fixed

[64] Sweet corn growers were drawn from the processors' list of growers through use of random numbers in southeastern Minnesota. Area sampling techniques were employed in drawing growers in all other areas. The general procedure followed is described in *Application of Probability Area Sampling to Farm Surveys*, Agr. Handbook 67, AMS, USDA, May 1954.

[65] Kline and Cravens, *op. cit.*, pp. 7-10.

[66] The cost of management and operation and overhead capital are assumed fixed and spread equally over each crop enterprise in the farm organization.

Table 18. Description of surveyed farms, six select Midwest areas, 1957

	East Central Illinois	Northern Illinois	Columbia County, Wisconsin	Sibley County, Minnesota	Faribault County, Minnesota	Southeastern Minnesota
Cropland			*(mean acres per farm)*			
Sweet corn	25	44	20	28	26	37
Peas	....	13	14	9	15	11
Field corn—all	86	101	40	63	83	55
Soybeans	102	12	2	39	58	39
Oats	23	35	33	29	26	30
Wheat	35	7	1	6	3	4
Other	2	3	5	9	3	3
Soil bank	1	9	11	1	3	6
Hay and pasture	34	58	52	31	21	44
Total cropland	309	282	178	215	238	229
Livestock			*(mean animal units per farm)*			
Dairy cattle	4	24	18	11	8	11
Feeder cattle	12	24	10	10	12	9
Total swine	8	13	31	14	8	10
Other (poultry and sheep)	2	1	20	4	3	3
Total livestock	26	62	79	39	31	33
Number of farms	37	31	34	32	36	33

Table 19. Net returns per acre from sweet corn compared with net returns from other selected farm crops, for six select Midwest areas (1956 returns)

Area		1956 returns by crop				
		Field corn	Soybeans	Wheat	Oats	Peas
ILLINOIS						
Northern	Mean dollar difference*	+29.98	−4.98	+24.13	−41.30	−12.27
	Number of farms	25	9	6	19	7
	"t" value	5.771†	1.216‡	2.511†	7.640†	1.207‡
East Central	Mean dollar difference	+40.21	+11.27	+29.32	−14.22	.....
	Number of farms	30	31	20	19	.....
	"t" value	10.324†	4.219†	6.167†	4.695†	.....
WISCONSIN						
Columbia County	Mean dollar difference	+17.17	.....	.....	−31.78	+14.77
	Number of farms	21	.....	.....	21	15
	"t" value	2.795†	.....	.....	5.730†	1.307‡
MINNESOTA						
Sibley County	Mean dollar difference	+27.18	+0.54	+12.09	−15.01	− 2.21
	Number of farms	26	24	8	24	5
	"t" value	6.017†	0.177§	1.826‡	5.677†	0.446§
Faribault County	Mean dollar difference	+36.75	+1.53	.....	−20.76	− 7.64
	Number of farms	20	18	.....	14	8
	"t" value	6.206†	0.370§	.....	4.188†	2.014‡
Southeastern	Mean dollar difference	+13.01	−20.19	−18.93	−29.92	+ 3.75
	Number of farms	23	22	5	23	5
	"t" value	2.612†	4.760†	2.790†	8.100†	0.176§

* Mean dollar difference is the net return per acre from sweet corn subtracted from net return per acre for the alternative crop.
† Significant at the 5% level.
‡ Significant at the 30% level.
§ Not significant at the 30% level.

and variable), seed, fertilizer, and storage costs (farm and rented) make up the total cost. Total per acre returns less per acre costs equal the net per acre returns. The "t" statistic tests the difference in net income. Only farms growing both crops are included in the comparison. For this reason, the number of farms in each area varies for each crop comparison.

Field corn was the most favorable crop alternative under both 1956 conditions and usual conditions, and its returns exceeded those of sweet corn by 13 to 40 dollars an acre. Sweet corn is in a more favorable competitive position with field corn in Columbia County, Wisconsin, than in the other surveyed areas.

Soybeans are a close alternative to sweet corn in most areas. Sweet corn returns in Sibley and Faribault Counties, Minnesota, and in northern Illinois do not appear to differ greatly from soybean returns. In southeastern Minnesota sweet corn was a more profitable crop than soybeans, under the favorable growing conditions of 1956. But under usual conditions sweet corn returns appear not to differ from soybeans. On the other hand, soybean returns in east central Illinois exceed sweet corn returns. Soybeans are not widely raised in Wisconsin. The low state average yield of about 14 bushels indicates poor relative returns from soybeans there.

Oats are a poor alternative to sweet corn. Wheat, although grown extensively only in a few areas, is a more profitable enterprise than sweet corn.

In Columbia County, Wisconsin, peas are a more profitable enterprise than sweet corn. But peas are grown under contract, often with the same canner as is sweet corn. The processor sets the price for both crops and sometimes makes joint production terms (see page 36, Part II). By varying prices the processor can affect the competitive picture between these two crops. That is, the processor establishes a price that will bring forth the desired quantity of both peas and sweet corn. Returns are thus jointly determined. Variation in return per acre represents differences in the relative merits of having the crops in the farm production plan, difference in yield risk, and difference in farmer attitude toward the two crops. Also, pea cultural practices are similar to small grains cultural practices, so peas are more readily thought of as an alternative to small grains. As a result of processor procurement activities, peas cannot be considered a close and possibly not even a competing alternative to sweet corn. Thus, in the picture in Columbia County, Wisconsin, there are no closeby alternatives to sweet corn.

YIELD AND PER ACRE RETURNS. The data presented above are influenced by a very favorable production year, yield and income-wise, preceding the taking of farm survey schedules. Information on what farmers felt were usual yields was obtained to improve results and to remove the effect of exceptionally high yields in 1956. In order to extend the analysis still further and to include yield variability, yields of alternative crops which give equal per acre returns with sweet corn were estimated.[67] The results for east central Illinois and Faribault County, Minnesota, are pre-

[67] The estimates were obtained from simple regression equations of yield determining net income per acre. Regression equations are of the following form:

$$Y_{sc_1} = a_{sc_1} + bX_{sc_1}$$
$$Y_{ac_1} = a_{ac_1} + bX_{ac_1}$$

where

Y_{sc_1} = net per acre return from sweet corn
X_{sc_1} = yield sweet corn
Y_{ac_1} = net per acre return from alternative crop
X_{ac_1} = yield alternative crop

Subscript 1 refers to the set of farms upon which yield and returns for both sweet corn and the alternative crop were observed.

The desired information is what yield of sweet corn will give a net return equal to

sented in figures 19 and 20. The lines in these figures trace points where yields give equal net returns per acre for the two crops. For example, in east central Illinois, a 3-ton yield of sweet corn under "usual" conditions returns about the same income per acre as a 35-bushel yield of field corn, a 16-bushel yield of soybeans, or a 65-bushel yield of oats.

The income position of sweet corn in Illinois is not altered by small changes in yields of competing crops as much as it is in Minnesota and Wisconsin. This is demonstrated by comparing the slope of equal return lines in figures 19 and 20 or by comparing the "b" values in Appendix, table D-1. In Illinois (northern and east central) about a 0.05-ton increase in yield of sweet corn is necessary to offset a 1-bushel increase in yield of field corn. In Minnesota and Wisconsin, about a 0.10-ton increase in sweet corn yield is required.

Put another way, small changes in yield of sweet corn would materially improve the relative profit position between sweet corn and other farm crops in Illinois. But in Minnesota and Wisconsin, a substantial change in yield of sweet corn may occur before the competitive position of sweet corn is altered, relatively speaking.[68]

Under "usual" conditions about a 6-ton per acre yield is required for sweet corn to return the same income per acre as field corn; a 4-ton yield is required for soybeans, and a 2-ton yield for oats.

FARMERS' OPINIONS. Farmer-growers included in the Minnesota farm survey were asked three general questions relating to what they considered as alternatives to sweet corn production. The questions were:

1. In the event that you had been unable to contract any sweet corn at all this year, what crop would you have grown in place of sweet corn?

2. If the price of sweet corn should rise or you should receive a guarantee of a higher yield and you increased your sweet corn acreage, what crop acreage would the increased sweet corn acreage come from?

3. Have you increased or decreased your acreage of sweet corn in the last five years? If so, what crops did you decrease or increase in order to increase or decrease your sweet corn acreage?[69]

Question No. 1 reflects farmer choice among alternatives when *decreasing* sweet corn acreage; question No. 2 reflects farmer choice when *increasing* sweet corn acreage; and question No. 3 reflects farmers' historical response when *both* increasing and decreasing sweet corn acreage.

Aside from Columbia County, Wisconsin, and northern Illinois, soybeans was the alternative most frequently cited, if sweet corn acreage were to be increased or decreased. Field corn was the alternative most often mentioned in Columbia County, Wisconsin, and in

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the net return from the alternative crop, as the yield of the alternative crop varies. Net return is to be held equal. To do this set

$$Y_{sc_1} = Y_{ac_1},$$

substitute for Y_{sc_1} and Y_{ac_1} and solve to get

$$X_{sc_1} = \frac{a_{ac_1} - a_{sc_1}}{b_{sc_1}} + \frac{b_{ac_1}}{b_{sc_1}} X_{ac_1}$$

Estimates are based on the average of 1954 to 1956 prices and on what farmers felt were "usual" conditions. Accounting procedures are the same as those employed in computing tables 19 and 20.

[68] The importance of this difference in yield phenomena between Illinois and Minnesota-Wisconsin becomes evident when one recalls: (1) yield of sweet corn increases with maturity, up to some point; (2) raw product destined for whole-kernel must be harvested earlier in maturity than raw product destined for cream-style; (3) Wisconsin and Minnesota pack mostly whole-kernel, while states farther south pack more cream-style; and (4) the more important competitive forces in the processor-grower market modifying prices paid farmers are from crops competing with sweet corn for farm resources. The implication here is that competition from other crops forces processors to allow the sweet corn crop to progress in maturity, and thus obtain a raw product to be packed as a cream-style finished product.

[69] The responses to these questions are shown in the Appendix tables D-3, D-4, and D-5.

Table 20. Net returns per acre from sweet corn compared with net returns from other selected farm crops, for six select Midwest areas ("usual" returns)

Area		"Usual" returns by crop				
		Field corn	Soybeans	Wheat	Oats	Peas
ILLINOIS						
Northern	Mean dollar difference*	+28.11	−1.32	+22.07	−31.01	+2.32
	Number of farms	23	9	6	20	5
	"t" value	7.563†	0.285§	2.718†	8.421†	0.330§
East Central	Mean dollar difference	+27.81	+14.10	+18.64	−16.45	.....
	Number of farms	31	32	20	19	.....
	"t" value	13.180†	7.308†	5.110†	5.160†	.....
WISCONSIN						
Columbia County	Mean dollar difference	+15.95	.....	.....	−26.18	+16.99
	Number of farms	22	.....	.....	22	16
	"t" value	3.398†	.....	.....	7.758†	2.268†
MINNESOTA						
Sibley County	Mean dollar difference	+30.01	+4.90	+17.18	−13.86	.....
	Number of farms	24	23	9	21	.....
	"t" value	11.842†	2.020‡	3.615†	5.748†	.....
Faribault County	Mean dollar difference	+27.13	+1.00	.....	−25.20	−5.10
	Number of farms	20	19	.....	16	6
	"t" value	6.090†	0.218§	.....	6.046†	0.924§
Southeastern	Mean dollar difference	+22.49	−3.60	+2.65	−21.45	.....
	Number of farms	16	15	5	16	.....
	"t" value	5.193†	0.998§	0.564§	6.397†	.....

* Mean dollar difference is the net return per acre from sweet corn subtracted from net return per acre for the alternative crop.
† Significant at the 5% level.
‡ Significant at the 30% level.
§ Not significant at the 30% level.

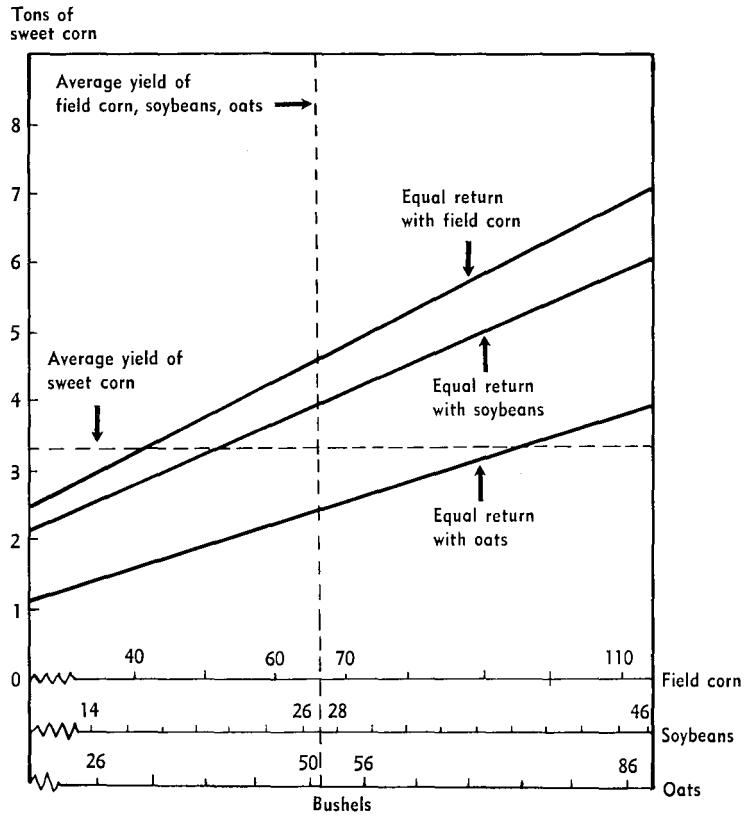

Fig. 19. Relationship between sweet corn yields and yields of field corn, soybeans, and oats when net returns per acre are equal, East Central Illinois, usual conditions.

northern Illinois. Sweet corn thus appears to be in more direct competition with field corn in Columbia County, Wisconsin, and in northern Illinois than in Minnesota or east central Illinois.

In farmers' opinions, soybeans and field corn are the more important crop alternatives to sweet corn. Small grains are hardly considered as an alternative in either area of Illinois. But they frequently are considered an alternative in Minnesota and in Columbia County, Wisconsin—especially when sweet corn acreage is to be increased.

Farmers' statements as to which alternative crop they historically increase or decrease in order to decrease or increase sweet corn acreage not only substantiate the pattern described, but also point out the impact of the government acreage allotment programs on sweet corn acreage. In northern Illinois, over 90 percent of the change in sweet corn acreage on surveyed farms was countered with a change in field corn acreage. The principal reason for this is that farmers who enroll in, and comply with, acreage allotment and soil bank programs cut back field corn acreage and plant sweet corn in its place. Government programs brought about similar phenomena in the other

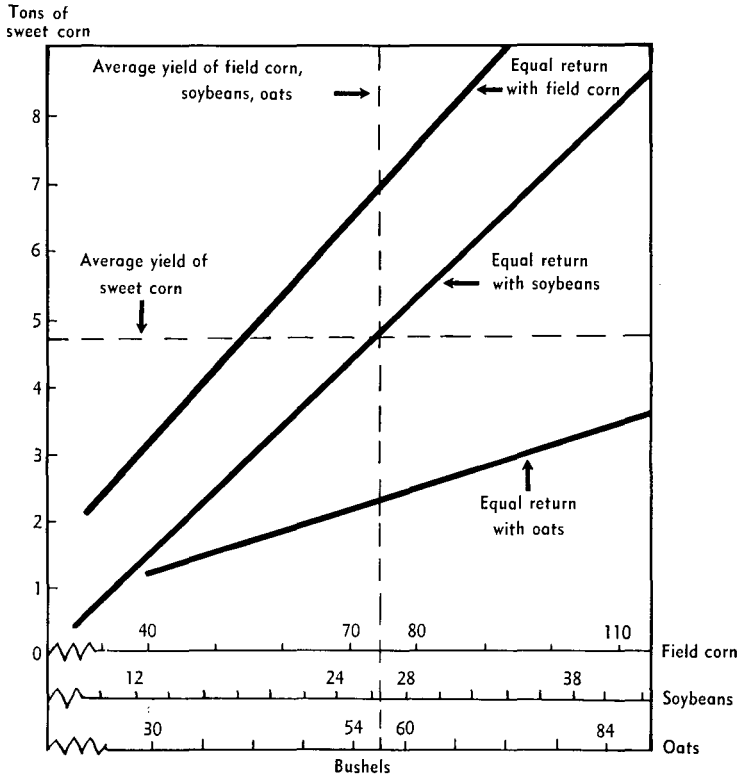

Fig. 20. Relationship between sweet corn yields and yields of field corn, soybeans, and oats when net returns per acre are equal, Faribault County, Minnesota, usual conditions.

five areas, but the effect was not so pronounced.

Turning to small grains, 14 farmers in all areas stated they increased or decreased small grain acreage in order to decrease or increase sweet corn acreage. Of these 14, 13 decreased small grain acreage to increase sweet corn acreage.

Special Advantages of the Sweet Corn Enterprises

Certain characteristics of sweet corn favor including it in the farm production plan. The distribution of labor requirements for sweet corn production throughout the year is one of the more important of these. This is particularly so in Minnesota. Sweet corn can be planted at various times in the spring. Total farm labor employed is reduced because the processor harvests the crop. But more important, early harvest allows fall plowing of the acreage, thereby lowering the demand for labor the following spring for land preparation. On the other hand, some combination of oats and soybeans will give similar labor distribution features, for soybeans is a late-planted crop and oats is an early-harvested crop.

Another more important characteristic of the sweet corn crop lies in its position in the crop rotation. The four reasons most often mentioned for in-

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cluding it in the farm crop rotation are: (1) early harvest for following with winter wheat (mainly in Illinois); (2) less soil erosion with sweet corn than with soybeans; (3) weed control easier with sweet corn than with soybeans; and (4) "green stock plowed under is good for the soil."

Winter wheat is planted early in the fall and harvested in midsummer of the following year. Parts of two growing seasons are required for one crop. Harvest of wheat takes place so late in the growing season that it is usually impossible to plant some other crop. In other words, 1 acre of winter wheat ties up 1 acre of cropland for 2 years. On the other hand, when it is possible to precede the wheat with an early-harvested crop such as sweet corn during the growing season in which wheat is planted, some crop can be harvested each year.

The advantage which sweet corn has over soybeans with regard to soil erosion and weed control is essentially a competitive relationship with small grains. Small grains are less subject to erosion than either field corn or sweet corn. On the other hand, sweet corn is the better crop for weed control. It is an intertilled crop, can be sprayed with a variety of weedicides after the crop is up without severe damage, and is harvested early, allowing for cultural weed control measures in the fall. These desirable features, however, can be also obtained through a production plan combining field corn and small grain.

The feeling on the part of growers that sweet corn is "good for the soil" is quite difficult to treat objectively. Claims made by farmers range from sweet corn being "not so hard on the soil" to its being "a soil-building crop." No research dealing with this aspect of sweet corn production was found. The general hypothesis among production scientists who were questioned on this matter is: Where sweet corn is plowed under in the green immature stage, the carbon-nitrogen ratio is favorable for rapid deterioration of the stock and nitrogen becomes free more quickly for the succeeding crop following than would be the case for a crop following field corn, for example, whose stocks are mature and dry when plowed.

This advantage—quick release of soil nitrogen—favors preceding wheat with sweet corn.

The labor and crop rotation benefits were most often mentioned in reply to questions calling for spontaneous answers about the advantages of the sweet corn enterprise.

Except in Columbia County, Wisconsin, few farmers considered silage privileges a major reason for growing sweet corn. But to these few farmers, growing sweet corn for silage privileges was especially important, because large quantities of silage were available from relatively small amounts of their cropland in sweet corn. In all areas, not only the cash-crop farmers but also many livestock farmers forego sweet corn silage privileges.

In all areas, a few farmers felt that some of their land, due to frost danger in low areas or to the presence of peat soil, was better adapted to sweet corn than to some alternative crop.

When the query was put specifically, a more or less guaranteed market at announced prices was considered a distinct advantage of sweet corn by a fairly large proportion of surveyed farmers. But when probed for reasons, few farmers were able to state why prices announced before planting and a guaranteed market were important to them. The advantage of preplanting announced prices, plus a guaranteed market, concerns risks associated with sweet corn production.

To generalize, to base sweet corn in production plans on certainty price and markets alone is to state a half truth with the more important aspects ignored. There are three major aspects to the problem.

(1) Price risks for sweet corn, where sweet corn is usually grown on multi-enterprise farms, can be viewed only in relationship to price risks associated

with other crops. Federal government price support programs lessen price risks associated with the more important alternative crops, and price risks among alternative crops frequently are no greater than those associated with sweet corn.

(2) Sweet corn appears to have a place in spreading overall farm risks. The inclusion of it in the production plan spreads income source over another enterprise — hedging against crop failure or near failure. Sweet corn is more or less a guaranteed source of income in the fall, and is a crop upon which farmers budget expenditures in meeting bills as they come due. The data obtained in the Minnesota Farm Survey indicate that diversification of sources of farm income and the sure income in the fall are important to growers.

(3) The guaranteed market aspect appears to be an important advantage in Columbia County, Wisconsin. From discussions with the county agricultural agent and surveyed farmers, the paucity of market facilities for alternatives to canning crops relative to the availability of market facilities found in other areas was pronounced. Fewer market places where field corn, soybeans, and small grains are sold suggest that producers of these commodities frequently must search out buyers, often with considerable effort. Fewer storage facilities suggest inability to hold these commodities in expectation of higher prices. On the other hand, the grower is assured (except for passed acreage) an outlet for his entire sweet corn crop at harvest.

The Nature of the Individual Farm Supply Curve and Its Effect on the Aggregate Supply Curve

Evidence obtained from the survey of sweet corn growers indicates individual farm output to be nonresponsive to price change over wide price intervals (see Appendix, table D-7).

The way three farmers stated they would respond to change in sweet corn price, pictured graphically in figure 21, illustrates the price-quantity relationship on individual farms. A change of more than 2 dollars in price would be required to bring about a change in sweet corn acreage on farm A. On surveyed farm B, less than a 1-dollar decrease in price would be required to bring about a decrease in acreage, although greater than a 2-dollar increase in price was required to encourage an increase in acreage. Sweet corn acreage on farm A would not vary over a 4-dollar price interval, and on farm B acreage would not vary over a 2-dollar price interval.

When an acreage change was indicated on one of the individual farms, the change was large (25 to 100 percent) in proportion to acreage currently grown.

On the other hand, when several farms are considered, sweet corn acreage tends to vary with less variation in price and the proportionate change in acreage tends to be of smaller magnitude. This phenomenon is also demonstrated in figure 21 by comparing curve S′ S′, the sum of the stated responses on three select farms, with response on any one of the individual farms. Sweet corn acreage changes with each specified price decrease when all three farms are considered, although acreage on any individual farm does not change with each specified decrease in price. Extending this example of three farms to a general case, as the number of farms increases, the curve describing the way acreage varies with price becomes "smoother" and tends to approach a continuous curve.

Summary of Farm Supply Structure

Soybeans are a "good" alternative to sweet corn in Minnesota and Illinois. But sweet corn is in a stronger competitive position, relative to soybeans, in Minnesota than it is in east central Illinois. Preceding winter wheat with sweet corn in the cropping system is

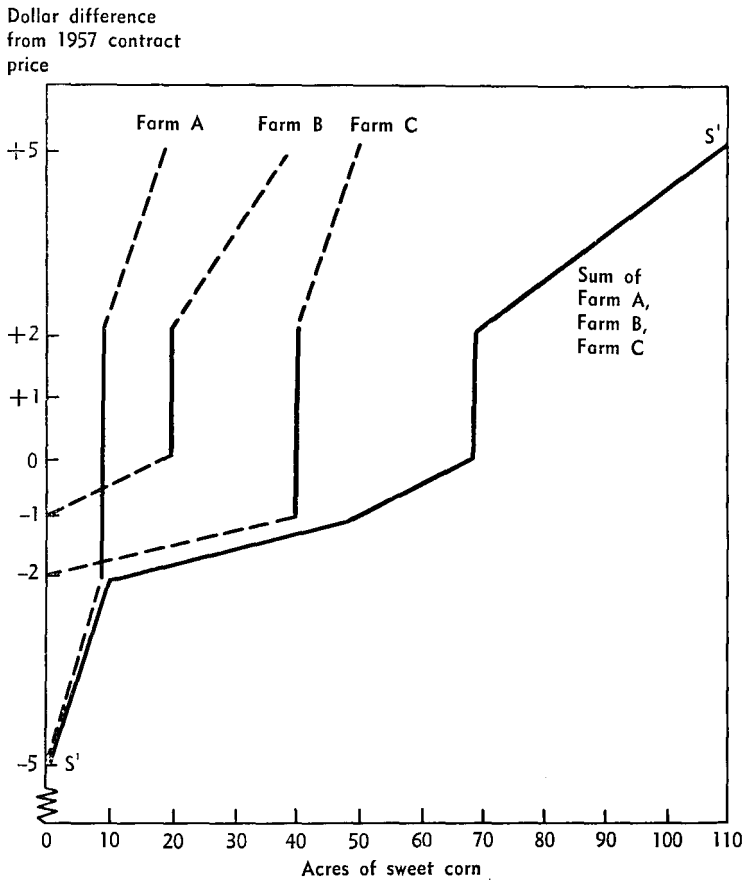

Fig. 21. Illustration of how three sweet corn growers stated they would have planned sweet corn acreage as contract price differed from the 1957 contract price, Sibley County, Minnesota, 1957.

the dominant factor determining supply in east central Illinois. Field corn appears to be a more important alternative to sweet corn in northern Illinois, and competitive pressure from it tends to force sweet corn prices to a higher level there than in the other areas. Small grains and field corn appear to be the important alternatives to sweet corn in Columbia County, Wisconsin, but neither is a very close one. Peas, because of processor joint procurement activities, cannot be considered as an alternative to sweet corn.

Sweet corn often competes with some combination of crops, including idle cropland as a crop, under a multiproduct type of farm organization. The sweet corn enterprise, therefore, does not have to be as profitable as some alternative intertilled row crops; it has to be only as profitable as some combination of crops with which it competes for farm resources.

Logically, an elastic supply of sweet corn in the Midwest, except in Columbia County, Wisconsin, would be expected in the light of the number

and closeness of alternatives. That is, a small change in price would be expected to bring about a much larger change in quantity.

Much of the equipment used in sweet corn production is identical with that used for soybean and field corn production, except for harvesting. And processors often supply the harvesting equipment. Thus, the sweet corn enterprise can enter and leave the farm plan without difficulty.

Almost every farm within transporting distance of a processing plant is a potential supplier of sweet corn, but many farms presently supply a zero quantity. For this reason, and because of the importance of sweet corn in the farm economy,[70] an elastic supply would be expected in all areas, including Wisconsin.

SUPPLY ELASTICITY FOR SWEET CORN

The object here is to present information on how responsive farmer-grown sweet corn output is to price change. We are interested in ascertaining the supply elasticity of sweet corn within a meaningful range. For example, the answer to the question, "Is the supply elasticity of sweet corn near 0.0, near 1.0, or near 5.0?" would add immeasurably to our store of knowledge. A question such as, "Is the supply elasticity for sweet corn 0.74 or 0.76?" is not meaningful; to expect such "precision" belies a number of problems in data classification and research methodology.

Three Estimates of Supply Elasticity

The supply elasticity for sweet corn is estimated by three methods: (1) a budget approach, based on maximum income plans for representative farms employing linear programming techniques; (2) a survey approach, based on farmers' opinions as to how they would vary sweet corn acreage with a variation in sweet corn prices; and (3) a time-series approach, based on correlation of annual prices paid growers with planted acreage in Ohio. Error and bias are present in each of the three methods. Reliance can be placed on estimates only when they are substantiated by estimates from each approach and *a priori* knowledge and reasoning.

The three estimates are summarized in table 21.[71]

VALIDITY OF ESTIMATES. A test for the validity of the estimates lies in the consistency of the estimates with one another and with *a priori* knowledge. Logically, sweet corn output should be quite responsive to price—probably a 1 percent change in price should be associated with a 1 percent or a greater change in quantity supplied. All three estimates are consistent with this reasoning.

Processor procurement activities cause estimates based on time-series data to be less elastic than the true elasticity. Elasticities developed from the budget approach and the survey approach, if representative of the "true" elasticity, should be greater than estimates based on time series. Comparison of the estimated elasticity for Ohio with that for east central Illinois would be the most appropriate comparison because of similarity in production conditions. The elasticity developed from time-series data is +1.3, less than the +4 elasticity developed from budget and survey approaches.

Fewer and more distant alternatives would cause the supply elasticity for sweet corn to be lower in Wisconsin than in other areas. The estimates from budget and survey approaches are $+2^+$ for Columbia County, Wisconsin, and +3 to +4 for the other areas.

[70] See Part I, p. 26.

[71] Estimates are developed in Appendix B.

Table 21. Farmer-grower sweet corn supply elasticity based on estimates developed from time-series data, budget, and from survey of farmer-growers, select Midwest areas

Area	Historical time series*	Budget linear programming*	Farm survey*	Approximation based on three estimates
Ohio	1.28	.....	.....	.....
Illinois	.....	.....	.....	.....
East central	.....	3.84	4.17	3.8
Northern	.....	.....	3.47	3.5
Wisconsin	.....	.....	.....	.....
Columbia County	.....	2.51	2.43	2.5
Minnesota	.....	5.20	.....	.....
Sibley County	.....	4.47	3.26	3.5
Faribault County	.....	4.65	3.16	3.5
Southeast	.....	.....	3.11	3.5

* Estimates are developed in Appendix B.

The three estimates of the supply elasticity for sweet corn—responsiveness of output to price change—appear consistent with *a priori* knowledge and reasoning. The data substantiate an elasticity of sweet corn supply of about +2.5 in Wisconsin and from +3.0 to +4.0 in Minnesota and Illinois.

The Meaning of an Elastic Sweet Corn Supply

The supply elasticities estimated above indicate farmer-grown sweet corn output to be very responsive to price change. They indicate a 20- to 40-percent increase in acreage forthcoming from a 10-percent increase in price. In other words, a 30-percent increase in production could be obtained from about a 2-dollar price increase over the 1954-56 levels—*if* other influencing factors remained constant.

FORCES POSITIONING AND SHIFTING SWEET CORN SUPPLY

Factors other than the price of sweet corn give rise to variations in supply. In fact, permanent shifts in supply have occurred in the past two decades that were equally as important, or more important, than the elasticity of supply when appraising production response. Introduction of the mechanized sweet corn harvester enhanced the competitive position of sweet corn relative to crop alternatives by reducing labor inputs.

On livestock farms, increased yield of feed crops meant that the same quantity of feed could be obtained from a smaller acreage. Some livestock farmers with fixed capital resources limiting their total number of livestock began to look to cash crops as a source of income from acreage no longer needed for feed production. Sweet corn is a good alternative, sometimes the best alternative, use of this cropland.

The introduction and expansion of soybeans as an alternative to sweet corn not only modified the supply elasticity but also played an important role in shifting the sweet corn supply curve.

Federal price programs materially affect sweet corn supply. The announcement of support prices prior to planting has removed considerable price uncertainty among crop alternatives. But more importantly, acreage restriction on field corn has increased acreage available for sweet corn production.

The impact of changing conditions that occurred between the 1935-39 period and the post-World War II period on sweet corn production and prices is shown in table 22. The effect of change in price of alternative crop on sweet corn prices is removed by deflating current prices by the index of prices received by farmers.

Table 22. Percent change in price paid farmer for 1 ton of sweet corn for processing* and change in sweet corn production between the periods 1935-39 and 1950-54, 1935-39 and 1955-57, select areas, United States

State	Change in price		Change in production	
	1935-39 to 1950-54	1935-39 to 1955-57	1935-39 to 1950-54	1935-39 to 1955-57
			(percent)	
East	.....	.....	+ 5.6	— 8.4
Maine	—34.5	—32.6	—52.9	—69.7
New York	—24.5	—19.5	+48.5	+21.7
Pennsylvania	—16.8	— 6.6	+47.2	+69.6
Maryland	—25.6	—20.8	+ 1.9	—11.5
Delaware	—13.2	— 2.8	+66.0	+60.4
Midwest	.....	.....	+60.4	+85.0
Ohio	—12.1	—12.9	—29.6	—56.8
Indiana	—18.8	—21.7	—33.0	—45.0
Illinois	— 2.4	+ 2.4	+22.5	+33.8
Iowa	+14.2	+17.0	—12.5	—18.0
Wisconsin	—10.5	— 5.3	+494.8	+630.5
Minnesota	— 5.9	— 1.8	+80.4	+134.0
West	.....	.....	+954.2†	+1,058.7†
Idaho	+11.5	+10.0	+739.1†	+ 823.5†
Utah	—22.9	—20.5	+1,131.7†	+1,227.2†
Washington	—16.0	—14.9	+1,048.1†	+1,038.5†
Oregon	—17.4	—13.8	+ 998.5†	+1,257.7†
United States	—12.6	— 9.0	+ 67.3	+ 83.5

* Deflated by the index of prices received by farmers (U.S. average).

† Exceptionally high due to scarcity of sweet corn for processing production in the West during the base period and the rapid expansion that occurred in West production during and immediately after World War II. Change in West production from 1950-54 to 1955-57 was 10.2 percent increase, or just slightly greater than the 9.7 percent increase in United States production during the same period.

Source: See source for table 13.

Two shifts are most noticeable—one resulting in increased supply in Wisconsin and one decreasing supply in Iowa. The price received by Wisconsin growers decreased about 10 percent between 1935-39 and 1950-54, while production increased about 500 percent. Although processors may have increased production of sweet corn with their own resources between those periods, it seems unlikely that their production would increase by such a spectacular amount. The more important forces shifting supply appear to be the substitution of tractor-power for horsepower and the increased yields of feed crops which released land for cash crops.

Price paid Iowa growers increased about 14 percent during the same period, while production decreased by about 12 percent. The most important force shifting Iowa supply appears to be the introduction and improvement of a better crop alternative, soybeans.

In Minnesota, a definite shift, increasing the supply of sweet corn, is noticeable. In the other Midwest states, changes in processors' sweet corn production and in the type of finished product packed influence observed data in such a way that movement of the supply function is indeterminate.

Prices of Alternatives

A change in the price of a crop alternative would cause farmers to change quantity of sweet corn supplied in the opposite direction. It would be useful to know the cross-supply function—that is, the change in sweet corn acre-

age associated with a change in price of some crop alternative—but it is unobtainable from available data with available facilities. A change in prices of all alternative crops affects the price of sweet corn via the overall price level effect, rather than by wooing acres away from sweet corn production.

Prices of individual crop alternatives to sweet corn vary yearly, causing price ratios to vary, and thereby resulting in an unstable supply. One of the large canners partly stabilizes the effect of varying crop alternative prices by relating prices paid growers for sweet corn to the price of field corn.

A change in the demand for or in the supply of the crop alternative is necessary, however, for a permanent change in prices. For example, a fall in export demand for soybeans followed by a fall in price of soybeans could increase the acreage available for sweet corn in those areas where soybeans is an important alternative. Shifts of the supply curve are most often a result of technological change.

Changing Technologies

Technological improvement, development of new varieties, increased use of commercial fertilizer, and development of specialized equipment in sweet corn production appear to have kept pace with the technological improvement among the crop alternatives. Developments are expected to keep pace. Sweet corn is a plant similar to field corn and some research on field corn may be adaptable to sweet corn.

On the other hand, the trend in technological developments appears to have favored sweet corn production in Minnesota and Wisconsin. Hybrid yellow varieties developed in the past three decades appear better adapted to Minnesota and Wisconsin growing conditions than to those in other midwest states. Also, research at state land grant colleges is associated with crops produced in the state. Where sweet corn is becoming concentrated in certain areas, emphasis on research will shift accordingly, thus favoring the present major producing areas.

Changing Institutions

The Federal acreage allotment program for field corn has shifted the supply of sweet corn.

Farmers surveyed in six leading producing areas said that 25 percent of the sweet corn acreage on their farms was affected by acreage allotment programs.[72] If they could grow all the field corn they desired but still stay in the Federal field corn support program, 20 percent of the farmers said they would grow no sweet corn. Twenty-one of the 203 farmers put their entire field corn acreage in the soil bank and for a row crop, grew sweet corn in its place.

To get some measure of the proportionate change involved with a change in acreage allotment, the field corn acreage was summed for farmers who said they would vary their sweet corn acreage with their field corn acreage allotment. A 10-percent increase in their field corn acreage allotment would bring about a 15-percent decrease in sweet corn acreage on their farms. When all surveyed farmers are included in the estimate, a 2.7-percent decrease in sweet corn acreage was associated with a 10-percent increase in field corn acreage allotment. When those farmers who are uncertain about their response to government allotment are included, the proportion is raised by 0.5 percent —to show a 3.2-percent change in sweet corn acreage associated with a 10-percent change in field corn acreage allotment.

It will be recalled that the estimated sweet corn supply elasticity is from 2 to 4 in the Midwest. An expected 3.2-percent decrease in sweet corn acreage, caused by a 10-percent increase in field corn acreage, could therefore be offset

[72] See Appendix tables D-8 and D-9.

by a 1- to 2-percent increase in the price of sweet corn. The existing output of sweet corn would thus be maintained. (The impact of a change in field corn acreage allotment on the farm supply of some individual plant might be considerably greater.)

It is, of course, implicit in the foregoing discussion of changes in institutions that other influencing factors have remained constant, i.e., prices and technologies. An institutional decision to increase acreage allotment for field corn while lowering the support price of field corn sets *two* forces to work shifting the supply of sweet corn, but in opposite directions. The increase in acreage allotment would decrease the supply of sweet corn, while the decrease in price of field corn increases supply of sweet corn. Possible solutions to this problem are indeterminate with available tools.

EFFECT OF PROCESSOR ACTIVITIES ON MIDWEST SWEET CORN OUTPUT

Three ways in which processors influence production of sweet corn in the Midwest are: (1) through raw product procurement activities; (2) by varying the type of product canned; and (3) by producing the raw product with processing firms' resources.

Procurement Activities

In recent years, the most important price practice influencing farmers' sweet corn output has been the processor's absorbing of the transporting cost from farm to canning plant, prorating it equally for all producers. This tends to increase the procurement area to include more distant growers, who otherwise would find sweet corn an unsatisfactory production alternative. (Employment of large tractor-trailer equipment in hauling the raw product is reported to extend the area of operation of one plant up to 200 miles.) Also, discriminate pricing of the raw product by per acre yields tends to extend the procurement area to include distant growers who obtain higher yields.

Numerous processor services provided farmer-growers are aimed specifically at increasing farmer-production. Financing production of the sweet corn crop is an example.

In most areas, the fieldman encouraged some farmers to grow sweet corn.[73] Personal relations with the canner, for example, if some member of the grower's family is employed by the canning firm or owns an interest in the canning firm, or friendship with the canner or fieldman are sometimes reasons for growing sweet corn. But a "one-sided" personal relationship will not likely endure. The hypothesis adopted is that the friendly relationship between processor and grower must be mutual. Based on this hypothesis and the fact that all canning plants have been in operation for a number of years, processor-grower relationships and processor service offered do not appear to be effective means for increasing farmer production.

Influence of Type of Product Canned

By varying the type of finished product packed, the canner can affect the position on his raw product supply curve at which he operates. The quality-yield research of Desrosier and others deals with quality factors of the raw product and per acre yield.[74] Their results indicate that per acre yield in usable ears of sweet corn for processing (a common pricing base) and cut corn varies with water content.

For example, suppose the canner has the alternatives of packing a cream-style type of finished product and a

[73] A very few farmers in select surveyed areas said that they would not initiate contract negotiation. They grew sweet corn because the fieldman asked them to do so.

[74] N. W. Desrosier, K. R. Johnson, and S. R. Miles, *Quality-Yield Relationships of Sweet Corn for Processing*, Ind. (Purdue) Agr. Exp. Sta. Bul. 654, May 1958 (N. C. Reg. Pub. 81).

whole-kernel type of finished product. The raw product would be harvested at the 70 percent water content level for cream-style.[75] The Farmer's yields of usable ears would be 108.37 percent of the index base. For packing the whole-kernel type at 74 percent water content, the farmer's yield in usable ears would then be 97.21 percent of the index base.

There is a substantial difference in yield—108.37 versus 97.21.

Sweet corn, on an acreage basis, must compete with other farm crops in terms of price per unit and number of units per acre. Assuming *price constant,* per acre returns would be substantially different depending upon processor decision between the types of product to pack. If the processor changed from packing all whole-kernel to packing all cream-style, grower returns per acre would be increased about 11 percent. Farmers would be willing to grow more sweet corn at the higher per acre return. The processor, by his own decision as to what product to process, is able to affect the quantity of raw product obtained at some price by an estimated 23 to 34 percent.[76]

Processor Production

The three major reasons why processors produce the raw product with their own resources are: (1) a variable and often unpredictable supply; (2) desire to obtain a raw product with a specific characteristic, physical or temporal (extending the period for processing); and (3) profit from raw product production achieved, both from actual per acre profit for each acre grown and from obtaining some desired total quantity of raw product at a lower average price.[77]

Yearly price variation and yearly yield variation among crop alternatives cause the supply function for sweet corn to shift. Processors are not always able to foresee a highly unstable supply correctly, and small errors in announced prices could result in large shortages of the raw product. Some processor production reduces uncertainty in acquiring the quantity of finished product the market demands.

These reasons are similar in that processor production is a more profitable alternative than contracting production with farmers.

Important cost considerations which influence the quantities which a processor will produce are contract rent, opportunity cost, and production cost with processor resources compared with the cost of the raw product delivered to the plant by farmer-growers. (Processors take advantage of production opportunities. One canner was observed to produce soybeans and field corn with his own resources and to contract his entire acreage of sweet corn in the summer of 1957.) Among these various costs, rent appears to be the most important. When contract rents are relatively low, the canner will tend to produce more of the raw product with his own resources and vice versa. The canner's cost of production, aside from rent, usually would be similar to that of farmers operating on a large scale. Economies of scale would tend to be equal.

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[75] *Ibid.*, table 5, p. 8.

[76] From the attribute columns listing how quantities vary with water content to maintain some per acre returns, base 73 percent water content:

$$\text{Usable ears} \quad \frac{108.37}{97.21} = 111.5$$

The effect on farmers of the per acre income decision to pack cream-style over golden whole-kernel amounts to a 11.5 percent increase in price. The estimate was obtained by multiplying this price increase effect by the elasticity of supply or 11.5 multiplied by an estimate elasticity of supply lying between 2.0 and 3.0.

[77] See Part II, page 38. Evidence supporting the presentation here of processor raw product production activities is found in Part II.

Section II. Competition with Other Producing Regions and the Midwest Share in Prospective Demand

THE PURPOSE of this section is to appraise the competitive position of sweet corn production in the Midwest with the production in other major producing areas and to appraise the Midwest share in prospective demand. The analysis is limited by the lack of data for full estimation of a detailed model representative of interregional production and consumption.[78]

FRAMEWORK AND METHOD OF ANALYSIS

Sweet corn is or has been grown in virtually every state in the Union. Discussions with canners indicate that the type of raw product necessary for packing the fanciest of grades of whole-kernel—the type of finished product imposing the greatest demand on the raw product—can be produced in almost all of the states. In spite of this, sweet corn production is concentrated in several centers, most of them a long distance from major consuming centers. Obviously, there are variations in cost of transporting sweet corn from producers to consumers. But these variations are not inconsistent with a least cost combination of resources, for transportation cost is only one of several major casual forces influencing location of production centers. A more important economic motivating force is explained within the theoretical framework of the principle of comparative advantage.

The principle of comparative advantage deals with the situation in which several commodities can be produced in several regions, yet some regions tend to specialize in certain commodities. The tendency to specialize grows out of the relative advantage in production among commodities in each region and the difference in this relative advantage (i.e., the comparative advantage) that exists between areas. One production area may be able to produce all commodities with fewer resources than a competing area. The favored area has an absolute advantage in production of all commodities and will tend to specialize in commodities for which the advantage is greatest. The disfavored area will tend to specialize in commodities for which the disadvantage in production is the least.

This principle was encountered in Part IV, Section I, but not discussed as such. Evidence presented indicated that soybeans are a close alternative to sweet corn in Illinois and Minnesota, but a distant alternative in Wisconsin. Sweet corn has a more favorable advantage ratio over soybeans in Wisconsin than in Minnesota and Illinois, and a more favorable advantage ratio over soybeans in Minnesota than in east central Illinois.

Either through the free market mechanism or through personal de-

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[78] The author is aware of three approaches with application to the problem at hand. These, with adaptation to agriculture, are found in the following:

(1) R. L. Mighell and J. D. Black, *Interregional Competition in Agriculture* (Cambridge: Harvard University Press, 1951). The analysis is based on conventional budgetary tools.

(2) G. G. Judge, *Competitive Position of the Connecticut Poultry Industry*, Conn. (Storrs) Agr. Exp. Sta. Bul. 318, January 1956. The analysis is based on simultaneous estimates of demand and supply function and optimal production and distribution obtained from linear programming solutions.

(3) Peretz Ram, "An Input-Output Analysis of a Small Homogeneous Agricultural Area," *Journal of Farm Economics*, XL, No. 5, December 1958, pp. 1909-20. This was a student award-winning paper presented at the 1958 annual meeting of the American Farm Economic Association. The analysis is based on a model introduced by Leontief in 1931. The basic model is published in W.W. Leontief, *The Structure of the American Economy* (London: Oxford University Press, 1951).

Data unavailable is knowledge permitting adjusting of a heterogeneous raw product to a homogeneous raw product. If average percentage of water content of the raw product when processed was available by regions, the adjustment might be possible.

cisions of large processors operating in monopolistically competitive markets, least cost combinations of productive resources are sought. Transportation costs and differences in relative production advantage (or disadvantage) between areas, as indicated by data presented previously in this study, are believed the primary causal forces determining where sweet corn is produced. Difference in processing costs—including labor, power, water, and supplies (can, label, and carton)—between production areas is negligible when compared with the variation in transportation cost and production advantage. Labor and capital resources flow between regions and costs tend to equalize among production areas. Migrant seasonal labor is used in many canning areas and often the wage rate is minimum wage scale, institutionally set by government action. Numerous public and private sources of capital exist for both yearly operating and long-range development outlays.

Due to bulkiness and perishability of the raw product, processing plants are located in the immediate area where the raw product is produced.

Location of new sweet corn canning operations would tend to be based on raw product and transportation cost. Once a plant is located, however, the owning firm will continue to operate it as long as operating costs (average variable costs) are covered. Contraction of operation in one area and expansion in another indicate that the latter area is favored either by (1) lower raw product cost, or (2) transportation cost to the consumption area.

The appraisal of the Midwest share in prospective sweet corn demand is based on transportation cost and raw product production advantage.

MIDWEST COMPETITION WITH OTHER PRODUCING REGIONS

Major Production Regions

The trade distinguishes three regions as East, Midwest, and West. Major producing states in the East are Maine, New York, Pennsylvania, and Maryland. Major producing states in the West are Washington, Oregon, Idaho, and Utah.

Plants canning a small quantity of sweet corn are found in a number of other states. Their existence is explainable on the basis of scale of operation and type of product packed. A few hundred acres of sweet corn can be contracted in almost any agricultural area the size of a Midwest county. An extra-standard grade of cream-style does not place high demands on the raw product. A canner selling on an extra-standard market can, when located near a major consumption area, compete favorably with the more distant canners. The protective barrier for the local canner is, of course, a transportation cost advantage to the consumption area. However, the proportion of total production accounted for by the "local" canner is very small, some 3 to 5 percent.

Competition between the major producing areas can be appraised only in quantitative terms. Price received by growers for sweet corn—as it reflects raw product cost, historical changes in prices and production, transportation costs, and type of raw product involved, as indicated by the finished product—appears to summarize and describe the impact of most economic forces at work modifying regional production.

Price Paid Growers

The price paid growers per ton of sweet corn indicates the cost of the raw product to the processor. The price per acre (price per ton multiplied by yield per acre) is representative of farm cost of production, including opportunity cost.

Theoretically, the price paid growers is determined by a derived demand function in the processor-grower market describing the quantities processors are willing to buy at various prices, and by the supply function describing quan-

Table 23. Seasonal average price paid growers for sweet corn for processing, and price per acre, select states and United States, 1950-54 and 1954-56

State	Price paid grower per ton of raw product		Per acre price*	
	1950-54	1954-56	1950-54	1954-56
East	*(dollars per ton)*		*(dollars per acre)*	
Maine	26.14	22.53	83.65	74.35
New York	22.66	20.50	67.98	61.50
Pennsylvania	24.74	25.13	59.38	70.36
Maryland	21.26	20.40	48.90	51.00
Delaware	21.42	22.60	57.83	56.50
Midwest				
Ohio	19.18	16.87	51.79	50.61
Indiana	20.78	18.20	37.40	43.68
Illinois	22.96	21.70	71.18	75.95
Iowa	20.94	19.60	56.54	60.76
Wisconsin	20.06	18.80	56.17	58.28
Minnesota	19.44	17.93	64.15	66.34
West				
Idaho	23.62	21.30	108.65	115.02
Utah	23.42	21.43	100.71	105.01
Washington	24.42	22.23	114.77	113.37
Oregon	30.38	27.03	130.63	129.74
United States	21.84	20.17	65.52	67.97

* Price per ton multiplied by yield per acre.

Source: USDA Statistical Bulletin 210, *Vegetables for Processing...1949-55*; and *Vegetables—Processing, Annual Summary, 1957*, AMS, USDA.

tities growers are willing to supply at varying prices for the product, other influencing factors remaining constant. The observed price, if the market were perfectly competitive, is the average cost to the processor of the observed quantity. But in Part II, imperfections were found in the processor-grower market. In Appendix B, it is demonstrated how the observed price-quantity data may not lie on the supply function in any one year. Processors grow sweet corn themselves. On the other hand, over a period of several years processors approximate a point on the supply curve, after unpleasant experiences of paying too high and too low prices. Under competitive pressure, processors would tend to equate their production activities with procurement from farmer-grower activities. Theoretically, processors would equate marginal cost of raw product production employing processor-owned resource with the marginal cost of raw product procured from farmer-growers, and not average processor per unit costs of products with price paid grower. Even though prices paid growers may not be identical with the per unit cost of processor-produced raw product, prices paid growers are an indicator of these costs.

Observed prices averaged over a period of years are the best available indicators of raw product costs, even though the observed prices and quantities in the processor-grower market do not necessarily lie on the derived demand curve for the raw product or on the farmer-grower supply curve in any one year. (A more important difficulty with comparing prices in the processor-grower market is that the raw product, between states, frequently is a different commodity, and observed prices paid are for different commodities.)

Since the Midwest is more distant from major consumption areas, production costs must be less for Midwest canners to compete with the nearer canners in the finished product market. Lower prices per ton for the raw prod-

uct in the Midwest (except Illinois) than in the East and the West indicate lower cost of the raw product to be a major factor in the competition of Midwest production with that of other areas (table 23).

On the other hand, per acre prices, which indicate cost of production including opportunity cost, are similar in the East and Midwest. Maine and Illinois are exceptions, with per acre prices substantially higher than those of other East and Midwest producing states. Input costs are substantially higher in Maine[79] and opportunity costs are substantially higher in northern Illinois.[80] Higher per acre prices in the West than in the Midwest indicate the cost of production, including opportunity cost, to be greater in the West.

Change in Prices and Production among Regions

Changes in demand, technology, transportation cost, biological factors, and other influencing forces that occurred historically tend to be reflected in prices and quantities produced. By observing changes in prices and quantities, the effects of these causal forces are viewed. The data on percent increase and decrease in prices and quantities by states presented (table 22, page 68), thus represent the effects of changing conditions in the past two decades.

Sweet corn production in the East changed little from the prewar era to post-World War II, while western production increased spectacularly. Expansion in New York and Pennsylvania production about equaled the decline in Maine production.

Some changes in technologies are reflected in price and quantity changes occurring in different states. Production conditions more suited for recently developed sweet corn varieties are found in the cooler climates. Introduction of the mechanical sweet corn harvester has favored large-scale production on farms. These new technologies have favored several states (Wisconsin, Minnesota, and Illinois) more than other sweet corn producing states.

Raw Product Price Competition among Regions—Transportation Orientation

Price paid growers per ton of raw product reflects the average cost of a unit of raw product delivered at the processing plant. This cost, taken by itself, offers little in the way of explaining the location of major production areas and the relative competitive position of one major producing area with another. The sum of the cost of the raw product and the cost of transportation of the finished product to the consumption area reflects, in a crude way, the relative competitive position of sweet corn production among areas.

The transportation oriented cost of the raw product in various major consumption areas is listed in table 24. The data presented were obtained from the following formula:[81]

Average per ton price received by farmers, 1954-56	+	Hundredweight finished product per ton of raw product	×	Transportation cost per hundredweight	=	Price of raw product in finished product market

[79] See W. E. Schrumpf and W. E. Pullen, *Cost and Returns in Sweet Corn Production, Central Maine, 1955*, Maine Agr. Exp. Sta. Bul. 550, August 1956; and B. F. Stanton and D. M. Stevens, *Costs and Returns in Producing Sweet Corn for Processing, 88 Farms, Western New York*, Cornell Dept. Agr. Econ. AE 1057, N.Y. Agr. Exp. Sta., January 1956.

[80] See p. 65, Part IV, Section I.

[81] The transportation cost per hundredweight is the carload rail rate for 60,000-pound carloads in 1957. However, smaller carloads are frequently the shipping unit, and truck freight is often used instead of rail freight. The 60,000-pound carload rail freight unit is employed here because (1) it is the least-cost of the rail freight alternatives, and (2) it approximates truckload freight rates on short hauls. Truck freight is the least-cost alternative only on short hauls; even then the saving over 35,000-pound carload rail shipment is often small. (See W. E. Pullen, *Marketing Maine Canned Sweet Corn*, Maine Agr. Exp. Sta. Bul. 548, June 1956.) Shipments on water routes were not considered.

Hundredweight of finished product per ton of raw product includes weight of edible canned corn, labels, and cases. Edible sweet corn canned per ton of raw averages 822 pounds of cream-style and 762 pounds of whole-kernel.[82] Cans (303 size), cases, and labels increase the weight of edible corn by 25 percent. (The 303 can is the more popular consumers' sale size.)

COMPETITIVE POSITION OF PRODUCTION REGIONS. Western canners appear to be in the favored position in the western markets, from Salt Lake City westward. Cost of raw products plus transportation cost is less when sweet corn is produced in Idaho and Washington. Iowa and Minnesota can favorably enter the Denver market area and points east in competition with the Far West producers.[83] Of the three major producing regions, the Midwest is in the most favorable competitive position for southern market areas from South Carolina south and west. Sweet corn produced in Ohio appears favored, costwise, for the Columbia, South Carolina, consumption center over production in Maryland, the closest eastern production center.

Ohio appears in a position to compete favorably with all eastern production centers in the Boston and New York City markets. Obviously, some factor is not included in this competitive picture. Ohio apparently, in a more favorable competitive position, is contracting in sweet corn production while Wisconsin and Minnesota are expanding sweet corn production. This factor is the raw product; it differs markedly between production areas.

Raw Product Price Competition among Regions—Type-of-Product Orientation

Processors select the stage of maturity at which harvest occurs according to type of finished product packed. Later periods are chosen for cream-style than for whole-kernel pack. The processor, by his selecting the type of finished product, influences the raw product acquired; this in turn affects the position on the supply curve at which the processor operates. (See pages 70 and 71, Part IV, Section I.)

Prices per unit paid growers located in the several producing areas are comparable only when adjusted for the differences in the raw product. A budget example will demonstrate the importance of the effect of the type of raw product procured on the relative cost position between areas.

As indicated elsewhere, Ohio appears to be in a more favorable competitive position for the New York City market than Wisconsin. But Ohio packs mostly cream-style, Wisconsin mostly golden whole-kernel. For this example, assume the cream-style is processed from a 68-percent water content raw product and whole-kernel processed from a 76-percent water content raw product. Adjustments now can be made for comparing costs based on difference in transportation cost and difference in cost of identical raw products by the following equation:[84]

Raw product price adjustment factor	×	Average per ton price received by growers, 1954-56	+	Hundredweight finished product per ton raw product	×	Transportation costs per hundredweight	=	Comparative price of raw product in the New York City market area

[82] Based on estimates of the AMS, USDA.

[83] Canning operations in Colorado and Utah modify the competitive picture. They tend to be instances of local canners protected from major production centers by the level of transportation costs.

[84] Computed from Desrosier, *et al., op. cit.*, table 5, p. 8. The equation is based on the weight of usable ears. This factor states the amount the price must be raised or lowered for equal returns per acre at the same water content of cut corn.

Table 24. Transportation-oriented cost of raw product in Golden Whole-Kernel finished product market, select production points and consumption points, average 1954-56 price, 1957 rail freight structure*

Shipping point	Destination: East		Southeast		Southwest	West			Midwest
	New York, N.Y.	Boston, Mass.	Columbia, S.C.	Atlanta, Ga.	Ft. Worth, Texas	Denver, Colo.	Salt Lake City, Utah	San Francisco, Calif.	Chicago, Ill.
	(dollars per ton)								
East									
Lewiston, Maine	26.63	24.82	.....	.....	.....	.....	.....	.....	31.58
Baltimore, Md.	23.07	24.97	25.83	27.16	34.78	.....	.....	.....	27.73
Rochester, N. Y.	24.31	24.88	.....	.....	.....	.....	.....	.....	26.31
Midwest									
Columbus, Ohio	22.97	24.30	22.97	22.68	28.87	28.20	.....	.....	20.30
Indianapolis, Ind.	25.63	26.30	24.77	23.72	29.15	28.68	.....	.....	20.77
Des Moines, Iowa	29.13	29.51	30.27	29.13	27.79	27.60	36.65	35.51	23.89
Madison, Wis.	27.09	27.47	27.09	26.42	23.52	29.37	35.85	34.71	20.90
Mankato, Minn.	27.55	27.84	29.17	28.31	27.46	26.60	34.03	33.84	22.98
West									
Boise, Idaho	39.78	.....	.....	.....	37.21	34.16	28.16	29.11	37.21
Yakima, Wash.	40.71	.....	.....	.....	38.14	35.09	29.09	30.04	38.14

* Based on whole-kernel cut weights and 60,000 pound carlot shipment.

Source: Rail freight rates are from Freight Rate Service Division, AMS, USDA. Prices are from table 23.

The following results were obtained by performing the operations specified for whole-kernel style:

State	Raw product price adjustment factor	Comparable price of raw product for whole-kernel pack in the New York City market area	
		1954-56	1957
Ohio	124.4	27.08	27.49
Wisconsin	100	27.09	26.89
Difference (Ohio-Wisconsin)		—.01	.60

The following results were obtained for golden cream-style:

State	Raw product price adjustment factor	Comparable price of raw product for cream-style pack in the New York City market area	
		1954-56	1957
Ohio	100	23.45	23.78
Wisconsin	80.4	24.05	23.90
Difference (Ohio-Wisconsin)		—.60	—.12

In this example, adjustment for difference in raw product procured reduced the raw product and transportation cost differential in the New York market area and altered the competitive picture. Golden whole-kernel could be produced cheaper in Wisconsin than in Ohio and shipped past Ohio to the New York City market area in 1957 by an amount of 0.60 dollars per ton of raw product. But Ohio still had a cost advantage over Wisconsin in cream-style production in the New York City market area of 0.60 dollars per ton of raw product for the period 1954-56, and 0.12 dollars in 1957. Ohio producers had the advantage in the golden cream-style type of finished product over the golden whole-kernel type of finished product by 0.61 dollars per ton of raw product for the period 1954-56, and 0.72 dollars per ton of raw product for 1957.[85]

Nonavailability and nonexistence of necessary data (percent water content) prevent appraisal of competition between major producing areas oriented in more refined analytical terms. The examples presented, however, indicate the importance in the competitive picture of the type of raw product procured. For lack of actual data on the type of raw product, a second-best indicator is the type of finished product packed in the various regions.

Eastern canners pack a higher proportion of golden cream-style than do Midwest canners.[86] The West packs a higher proportion of golden whole-kernel than the East, but less than the Midwest. A large proportion of the pack in Minnesota and Wisconsin is golden whole-kernel in style.

Market Imperfections and Competition among Producing Regions

Certainly imperfections in the finished product markets have an influence on competition among regions. Advertising *may* have quickened the consumption shift from white cream-style to golden whole-kernel form of product. Canner activities *may* have slowed the development of frozen sweet corn in the Midwest. Processor decisions to locate plants in specified areas de-

[85] Relative weather attributes influencing harvest and time-span for harvest are also important in the competitive picture, but their importance can be reduced through improved management of harvesting and processing operations.

[86] *Canning Trade Almanac, passim.*

termine production to a great extent.

Entry into the processing of sweet corn is, however, reasonably free and relatively easy. Fear of additional rivals and the search for profits encourage even the larger firms selling on monopolistically competitive markets to seek least-cost combination for raw product, processing, personnel, and transportation outlays. Location of raw product production is based on a least-cost combination of resources, even with the presence of a monopolistically competitive market.

THE MIDWEST'S SHARE IN THE PROSPECTIVE DEMAND

The very elastic and favorable shifting supply indicated in Part IV, Section I, means that the Midwest could increase production with little or no increase in cost of raw product. The more important set of forces determining the Midwest's share in prospective demand lies in the market for the finished product. The Midwest competes with the two trade-defined production regions, East and West, in four general market regions: East, South, West, and Midwest regions. The Midwest has a recognizable least-cost advantage for the Midwest market region and the South market region. These appear to be assured market regions for Midwest producers under the present cost structure. Midwest producers have such a disadvantage in the Far West that the western markets are almost closed to them. They are, however, in a more favorable competitive position with eastern producers for eastern markets.

The position of Midwest producers in prospective development is approximated from this information.

Size of Market Region

Population is a measure of the size of a market region. The market demand for sweet corn in the region is determined by income, price of sweet corn, price of substitutes, and tastes and preferences, as well as by population. The appraisal of the Midwest share in prospective demand, however, is based on population, or size of market, alone. The implicit assumptions involved in this step mean per capita consumption is assumed to be the same throughout the United States. Also, increases in population are assumed to be at the same rate in all areas.

Justification for these assumptions is found by examining the alternative. Predicting prospective regional differences in per capita income, regional differences in tastes and preferences, regional differences in prices of substitutes, and regional differences in rate of increase in population is beyond the scope of this study.

The "Floor"

Supplying market regions in which the Midwest has a definite least-cost advantage over other competing production regions would appear to be a realistic minimum expected share for the Midwest in prospective demand. As indicated above, the Midwest has a cost advantage in the Midwest and the South market regions.[57] Not only does transportation cost bar the West market region to Midwest production, transportation cost also bars Midwest markets to western producers. High transportation and raw product costs tend to bar western producers from southern markets.

The "floor" or minimum expected Midwest share in the prospective de-

[57] States included in the Midwest region are: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Nebraska, North Dakota, South Dakota, Missouri, and Kansas. Southern states included in southern markets are West Virginia, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas. Eastern states included in the East market region are Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Virginia, and North Carolina. Western states included in the West market region are Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, and California.

Table 25. Proportion of sweet corn for processing produced in the Midwest, with projection

	Actual	"Floor"	"Ceiling" by demand potential level*	
			Low potential	High potential
	(percent of total production)			
1948-57	69.8	.....	.....	.....
1954-56	70.2†	.....	.....	.....
1955	71.0	.....	.....	.....
1960	.....	53.2	71.3	71.6
1965	.....	53.2	71.9	73.0
1970	.....	53.2	72.6	74.3
1975	.....	53.2	73.3	75.5

* Based on data presented in table 16 (Part III). The high potential is based on the highest demanded potential of Model I and the low is based on the lowest estimate of Model II.

† Eastern producers' share was 14.2; western producers' share was 15.6.

mand throughout the decade is 53.2 percent of the total United States production (table 25). The estimate was obtained by dividing population in the Midwest and South market region by the total United States population for the base year, 1955.

The "Ceiling"

Supplying market regions in which the Midwest has a definite least-cost advantage and supplying a part of the East would appear a realistic expected maximum share in prospective demand for the Midwest. The maximum Midwest share in the eastern markets appears to be the potential increase in consumption in the East in addition to its current share in the eastern markets. The competitive picture shown in table 22 (page 68) indicates this to be a realistic share. Production in the East changed little between 1935-39 and the post-World War II periods. Price (in terms of constant dollars) that was paid farmer-growers fell considerably over this period in most eastern producing areas. In other words, considerable adjustment was necessary for eastern producers to maintain the pre-World War II level of output in the postwar years, not even considering the maintaining of their share in an increasing demand.

The "ceiling," or maximum expected Midwest share in prospective demand, varies from a position of producing 71.9 percent to 73.0 percent of the United States total production in 1965, and from 73.3 to 75.5 percent in 1975 (see table 25).[88]

Discussion of "Ceiling" and "Floor"

The "floor" or minimum expected Midwest share in prospective demand appears to be a pessimistic one. Historically, the Midwest share in total production never was as low as the "floor." (See figure 2, Part I.) The Midwest share in the United States total market probably never will fall as low as the "floor."

[88] Estimates of the "ceiling" were obtained by the following formula:

$$100X \frac{AB + (AC-C)}{A} = \text{Midwest's share in projected demand}$$

Where

A = Projected disappearance (consumption), from table 16 (Part III).

B = Percent of total United States sweet corn for processing produced in the Midwest, 1954-56.

C = Percent of total United States sweet corn for processing produced in the East, 1954-56.

AB = "Index" of sweet corn for processing produced in the Midwest, assuming Midwest maintains present share in eastern markets.

(AC-C) = "Index" of Midwest's increasing share in eastern markets.

Table 26. Projected percentage change in sweet corn for processing production in the Midwest from 1954 to 1956 average

Year	Suggested most likely*	Floor by demand potential level†		Ceiling by demand potential level†	
		Low potential	High potential	Low potential	High potential
		(percent change from 1954-56)			
1960	+12.0	−18.2	−15.9	+ 9.6	+13.2
1965	+21.7	−13.6	− 5.3	+16.8	+30.1
1970	+33.7	− 9.1	+ 6.9	+24.0	+49.3
1975	+48.1	− 3.8	+21.3	+32.5	+72.2

* Based on "ceiling" Midwest share in demand and Model II projection of AA fertility rate.

† Based on data presented in table 16 (Part III) and table 25. The high potential is based on the highest demand potential of Model I; the low potential is based on the lowest estimate in Model II.

The "ceiling" appears more realistic of prospective developments, in view of the historical positions and the apparent advantages of Midwest production.

The effect of an increasing canned sweet corn demand on Midwest production, a changing Midwest share in prospective demand, is presented in table 26. This prospective change in production is presented as an indication of expected trends, not as an estimate of actual production in any year.

A more likely potential for Midwest production in 1965 is about a 22-percent increase in production above the 1954-56 level, and for 1975 about a 34-percent increase in production.[80]

[80] Estimates were obtained as follows:

$$100X \frac{A \times D}{B} - 100 = \text{Projected change in Midwest production}$$

Where

A = Projected disappearance (consumption), from table 16 (Part III).
D = Midwest share in projected demand, from table 25.
B = Percent of total United States sweet corn for processing produced in the Midwest, 1954-56.

PART V (SUMMARY).

MIDWEST SWEET CORN INDUSTRY IN THE DECADE AHEAD

CHANGE IS THE RULE rather than the exception in the sweet corn industry. In the last three decades these changes have taken place: the vacuum type of pack was developed and expanded; the predominant type of canned product demanded shifted from a white cream-style to a golden whole-kernel type; a quick-cook canning process was developed; new, high-yielding varieties were bred; canned corn on the cob was introduced, only to be replaced by frozen styles; freezing techniques were developed and improved; major shifts in production areas of sweet corn for processing took place; and "out-of-season" fresh market production increased. The change in the type of finished product demanded was the important force affecting sweet corn for processing, while changes in supply (out-of-season supply) was the important force affecting sweet corn for market.

The processor, due to his position in the market structure, has played the dominant role in sweet corn for processing developments by introducing new varieties and new processing techniques, and promoting new products. The processor's role is likely to remain highly important in future developments.

SWEET CORN FOR PROCESSING

As indicated by past experience, a change in the type of finished product is likely to occur in the next decade. The effect on demand for *all* processed sweet corn, on the other hand, is likely to be negligible, with the new type of sweet corn product being substituted for some other older item. The increasing demand for canned sweet corn that has been experienced in the past three decades was associated with a rising real income, increasing consumption of all processed vegetables, and an increasing population. In the foregoing analysis, it was impossible to demonstrate that the change in type of finished canned product demanded was associated with the increasing demand. In other words, the golden whole-kernel style appears to have been substituted for white styles of finished product, while demand for all canned sweet corn increased.

Projections indicate a 20- to 40-percent rise in demand during the decade ahead. Two exceptions affecting realization of this potential lie in prospective technologies. These are: (1) improvement of frozen corn on the cob to give it a fresh corn on the cob quality, and (2) quality maintenance improvements of fresh market sweet corn, carrying the "freshly picked" characteristics through to the consumer. Improved frozen corn on the cob could place a processed product in a more favorable competitive position with fresh market sweet corn, particularly the out-of-season type.

An increased demand (derived) for sweet corn for processing could result from such a development, and actual demand for sweet corn for processing would expand by a greater amount than the potential developed in this study. On the other hand, develop-

ments favoring out-of-season fresh production *could* result in the fresh product being substituted for the processed product, with potential Midwest expansion not materializing.

Change in type of product processed, from canned to frozen or to some new process such as irradiation, is more likely to effect a change in *some* processing plant equipment, rather than to modify drastically prospective developments in sweet corn production for processing if change in raw product requirements are minor.

Sweet Corn Supply in the Midwest

Output of sweet corn for processing in the Midwest appears very responsive to price change. A 1-percent change in price is estimated to be associated with a 2- to 4-percent change in quantity of sweet corn offered. Increased Midwest output of sweet corn for processing appears possible with but little increase in price.

Also, improved farm technology historically has increased supply—i.e., shifted supply, increasing quantities offered at the various prevailing prices, in Wisconsin and Minnesota. Between pre- and post-World War II periods, sweet corn production in Wisconsin increased about 500 percent while the price ratio to other farm commodities decreased 10 percent. In Minnesota, production increased 80 percent while the price ratio fell about 6 percent. The shift in sweet corn supply in these two leading producing states indicates the possibility of increased output at no increase in price. Put another way, an increased demand for sweet corn does not necessarily mean increased prices for the raw product. Supply at the same time may increase by an equal amount, leaving prices unchanged.

More important in the potential output picture is the relative advantage Wisconsin and Minnesota have in sweet corn production over other Midwest states. Yields per acre obtained in Minnesota are higher than those in other Midwest states. Yields obtained in Wisconsin are about the same as those in the remaining states. But, because the type of product differs among the Midwest states, the observed yields obtained by growers in Minnesota and Wisconsin are lower than comparable yields for a similar product in the other states. After adjustment for difference in type of product, Wisconsin and Minnesota have an absolute yield advantage for comparable commodities.

A survey of farmer-growers was made in six select areas in Illinois, Wisconsin, and Minnesota to collect information on returns from farm crop alternatives. The comparison of per acre returns from sweet corn with other alternatives indicates that it has a greater income advantage over soybeans in Wisconsin and Minnesota than it does in east central Illinois. When compared to field corn, it has a greater advantage in Wisconsin than in either Minnesota or Illinois.

Competition with Other Production Regions

The Midwest states have maintained a fairly stable share of around 70 percent in the United States processed sweet corn market. A spectacular rise in western production in the past two decades was offset by a decline of eastern producers' market share. Eastern producers barely maintained the prewar actual production level. The Midwest maintained its position in the United States market through capturing the East's share of an expanding demand. Because new technologies and large-scale production techniques are more adaptable to Midwest production conditions, the Midwest appears to be in a position to continue to capture the East's share in an expanding demand.

High transportation costs of the finished product all but closes the Far West markets to Midwest producers. But high transportation costs and higher raw product costs in the West are protective barriers for Midwest producers in midwestern and southern markets. A column of sparsely popu-

lated states from Montana to New Mexico forms a "continental divide," separating western producers from producers in other parts of the United States.

An increasing share in the prospective United States demand is a most likely prospect for the Midwest taken as a whole. Projections indicate that Midwest output will increase by a third in the decade ahead.

Role and Position of the Processor in Prospective Developments

The processor's key role is essentially that of integrating two markets, the raw product market and the finished product market, bringing both into harmony. Operational advantage in the raw product market (processor-grower market) is obtained by seeking least-cost combination of transportation and raw product costs. Where the processor is the single buyer or one of a few buyers in the processor-grower market, the processor procurement policies and the prices paid growers are modified chiefly by farmers' crop alternatives.

Competitive advantage comes from differentiating the finished product and creating a unique demand for it. Large processors place major emphasis on their finished product marketing activities, modifying their raw product market activities accordingly.

Product competition is often substituted for price competition in the finished product market, and competitive research is a part of the industry. A change in type of finished product sold is likely to occur. This type of competition is not new to the industry and it does not follow that a shift in demand for all processed sweet corn will take place. Substitutes for sweet corn are being improved at the same time to neutralize the effect of product change and/or product improvement. The net result of product competition may be only the encouragement of increased concentration of processing in a few firms.

Farmer-Growers' Share in Future Developments

Of major importance to farmer-growers is how they will fare in future developments.

In the first place, increased demand for the raw product may not indicate an increase in the demand for acreage, since it may be satisfied from increases in yield. Yields in the post-World War II years increased about 30 percent. A 30-percent additional yield increase, thereby increasing output by about the same amount as demand increases, would mean little change in demand for crop acreage.

The second factor determining how farmers will fare in prospective demand is how much sweet corn for processing will be produced with processor's resources. This will be determined by the relationship between the cost of the raw product obtained from farmers and the cost of raw product obtained from the processor's resources. Many and different types of cost enter the picture, of which actual production cost is but one. A processor can profitably produce sweet corn with his own resources so long as his delivery to the plant cost is less than the price paid growers plus cost of fieldman services, cost of other services provided growers, and overhead costs of recording grower accounts. Other cost factors are the risk aversions in the assurance of a source of raw product, and the improvement of the processor's bargaining position in the market.

Processors, under the present market structure, may obtain a portion of the raw product from their own resources even though their average production costs are higher than those of farmers. The equilibrium level of processor operations is at that output where the marginal cost of delivering the raw product to the plant from processor-owned resources equals the marginal cost to the processor of farmer-grown raw product delivered at the plant. For this reason, farmers' prospects in future developments cannot be appraised from

a comparison of the farmer-grower's average production cost with the processor's average production cost.

The more important costs determining processor production are contract rent and farmers' opportunity costs of owned resources. Forces determining farmers' opportunity cost also modify contract rents in the same directions—i.e., higher prices for crop alternatives increase opportunity cost of resources employed in sweet corn production, while at the same time higher prices of crop alternatives tend to increase contract rent charge. In the absence of technological change, farmers could expect to share proportionally with processors in future developments.

A more serious threat to farmers is the adoption of production technologies. The adoption of super-capacity equipment by processors (e.g., 8-row tillage equipment) may modify the processor's cost structure in such a way that his production will increase. The balancing force is increased adoption of technologies by farmers. On the other hand, in adoption of technologies farmers are not likely to keep pace with the larger processors. Large processors employ research staffs to develop and adapt new technologies and often are in a better capital position, compared to farmers as a whole, to adopt them.

Some expansion in processor raw product production activities can be expected with moderate prosperity and rapid technological change in sweet corn production for processing.

SWEET CORN FOR FRESH MARKET

It appears that important changes are underway for all fresh market vegetable production, with production shifting from nearby crop farms to more distant specialized farms, and an increase in out-of-season production taking place. Around the largest cities, expansion of suburbs has taken up farmland previously in vegetable crops. Expansion of chain store operation into smaller communities and the servicing of the chain retail outlet from centrally located depots has shrunk the market outlets of truck gardeners supplying these smaller urban centers.

A spectacular increase in Midwest fresh market sweet corn production is not likely. Sweet corn for fresh market is a bulky crop and high costs are incurred when it is shipped long distances. The market season for Midwest-produced fresh market sweet corn is short and the product can be grown in many areas during the Midwest production periods. Sizable expansion into new market outlets outside of the Midwest would not be anticipated.

Expansion in demand for Midwest-produced sweet corn for fresh market would be expected to follow population increases and a rise in real income within the Midwest.

POSITION OF SWEET CORN IN THE MIDWEST FARM ECONOMY

Sweet corn will continue to play about the same role in the total Midwest farm economy in the decade ahead as it has during the past decade. Among the Midwest states, sweet corn has the most important place in the Wisconsin farm economy; and, in view of Wisconsin's comparative advantage in sweet corn production, its importance is likely to increase as production shifts in the Midwest to better adapted areas.

In other Midwest states, sweet corn will continue to become more important to localized farm economies having a comparative production advantage, particularly at present in the southern half of Minnesota, and selected areas in northern Illinois and northern Iowa.

Agricultural research in land-grant colleges is usually related to farm commodities produced in the state. As shifts in production occur, emphasis on sweet corn research will change accordingly. The shift in research emphasis lessens the possibility of a reversal of the trend, for reversing the trend depends, in part, upon the breeding of sweet corn varieties that are (1) higher yielding in warmer climates, and (2) equally as acceptable to consumers.

APPENDIXES

Appendix A. Demand Estimating Procedures

ECONOMIC THEORY of market demand provides the basic model for estimating the income-consumption relationship for sweet corn from time-series data. The theory states that the quantity of a commodity demanded at retail level is some function of the price of commodity, population, real income, tastes and preferences, and the price of substitute commodities. Forces affecting the quantities of canned sweet corn demanded are discussed under the section entitled "The Determinants of an Expanding Demand."

Unbiased estimates of the parameters for the statistical model as developed from economic theory are desired. Recent work in econometrics proves least-squares estimates of the coefficients of an equation are biased when two or more variables are jointly determined in the equation.[1] Such appears to be the case with the demand equation for canned sweet corn. Variation in canners' carryover stocks over time indicates that the quantity of sweet corn supplied in a given period is in some way affected by price in the same period. This means that quantity and price are jointly determined in a given year, and hence are jointly determined in the demand equation. Unbiased estimates can be obtained by "simultaneous equation" techniques. For the present problem, a complete system can be obtained by introducing an equation or equations explaining the quantity supplied.

The quantity supplied at the retail level is assumed to be some function of price, inventories, and weather. Inventories reflect available supplies at the beginning of the year and planned production during the year. Weather greatly modifies actual production during the year. Obviously this equation does not completely explain quantities annually supplied at retail, but it is believed to be a workable approximation. Other models which would explain more behavior on the supply side were estimated, but coefficients so estimated were not acceptable on *a priori* grounds.[2]

The statistical model to be estimated is:

Demand Equation

A-1 $$y_1 + b_{12}y_2 + c_{11}z_1 + c_{12}z_2 + c_{10} = u_1$$

Supply Equation

A-2 $$y_1 + b_{22}y_2 + c_{23}z_3 + c_{20} = u_2$$

y_1 = Per capita disappearance of canned sweet corn.
y_2 = Retail price of canned sweet corn (average U. S. in real dollars).
z_1 = Per capita income (U. S. in real dollars).
z_2 = Per capita disappearance of all other processed vegetables (canned and frozen).
z_3 = Per capita January 1 inventories of canned sweet corn.
u_1 = Nonobservable disturbances in the demand equation.
u_2 = Nonobservable disturbances including weather in the supply equation.

[1] See William C. Hood and Tjalling C. Koopmans (ed.), *Studies in Econometric Method*, Cowles Commission Monograph 14 (New York: John Wiley and Sons, Inc., 1953). In particular, Chap. IX, "Sources and Size of Least-Squares Bias in a Two-Equation Model" (by Jean Brofenbrenner), has specific reference to the problem involved here.

[2] Twelve models were estimated. The model presented here was chosen on *a priori* specification that the price-quantity relationship be negative in the demand equation and positive in the supply equation, on amount of economic behavior explained and on reasonableness of coefficients.

This statistical model is similar to one suggested by economic theory. The number of people in the market is held constant by employing per capita data. Prices of all commodities are held constant by deflating the price of sweet corn and per capita income by the Consumer Price Index. The quantity of other processed vegetables is included as a variable in the statistical model rather than the price of substitute commodities as prescribed in economic theory. This was done for two reasons: (1) a price for close substitutes or a good facsimile of it was not available; and (2) quantity of vegetables is determined to a large degree by weather conditions and prices prevailing in the previous year. Therefore, quantity is more independently determined in relationship to the price of sweet corn than is the price of other vegetables.

VARIABLES IN THE MODEL

Quantity demanded and quantity supplied of canned sweet corn are the AMS estimates of per capita, calendar-year consumption on a net canned weight basis. (Source: unpublished material supplied by the AMS, USDA.)

Income is disposable personal per capita annual income expressed in terms of 1947-49 dollars as developed by the Agricultural Economics Division of AMS. (Yearly per capita income in current dollars divided by the Consumer Price Index.)

The quantity of other vegetables is the per capita consumption of all other canned vegetables for the years 1925 through 1936, and the total of all other canned vegetables and all frozen vegetables from 1937 on. (Source: *The Vegetable Situation*, AMS, USDA, October, 1955.)

Inventories of canned sweet corn are the quantities on hand January 1—canners' and distributors' stock—as used by the AMS in estimating per capita disappearance divided by January 1 population. (Source: unpublished material supplied by the AMS, USDA.)

The observations for these variables are shown in table A-1.

OBSERVATION PERIOD

The observation period is the calendar year beginning January 1 and ending December 31, rather than the pack year beginning August 1 and ending July 31. Estimation on a pack-year basis would be preferable, because many economic decisions on the supply side are made on a pack-year basis. But the data are available only on a calendar-year basis and sufficient information to adjust to a pack-year basis is not available.

The observations are for the years 1925 to 1941 and 1948 to 1955. World War II years and 1947 are omitted because they are atypical, due to wartime conditions with extreme consumer commodity shortages and food rationing.

THE ANALYSIS AND ITS RESULTS

The analysis was carried out in terms of first differences of logarithms in order to remove part of the trend influence (including changes in tastes and preferences). The constant term is an indication of trends.

The estimated equations are as follows[3] (logarithm notation omitted):

A-3 $$y_1 = -0.0151 - \underset{(0.4193)}{1.1978}y_2 + \underset{(0.2741)}{0.5588}z_1 + \underset{(0.2468)}{0.6677}z_2$$

A-4 $$y_1 = 0.1227 + \underset{(21.6542)}{12.9434}y_2 + \underset{(1.3945)}{0.8528}z_3$$

[3] Estimating procedures are those outlined by Joan Friedman and Richard J. Foote in *Computational Methods for Handling Systems of Simultaneous Equations with Applications to Agriculture*, Agr. Handbook 94, AMS, USDA, November 1955. Notations are those used by Friedman and Foote.

Estimated coefficients in the demand equation appear reasonable. The income coefficient of 0.5588 appears high in view of the income relationship found in cross-sectional food-consumption studies. One explanation of this lies in the changing income distribution and the movement of income distribution over the consumption pattern pictured in cross-sectional studies.

Another explanation lies in the area of product improvement. Product improvement and increases in income occurred concurrently over the estimation period, and the effect of product improvement may be manifested only in the income variable. The possibility of this second explanation is supported by the negative constant term in the demand equation (A-3). The negative constant term indicates a decreasing trend in per capita consumption. Also, in four other models which include time-trend variables or a product-type variable (golden whole-kernel as a percentage of total pack), the estimated "trend" variable was either very close to zero or it was negative.

The positive coefficient for other processed vegetables would not be expected on *a priori* grounds. An explanation for this positive coefficient might be that the rise in real income and other general factors causing increases in processed vegetable consumption over the estimation period increased the demand for all processed vegetables to such an extent that a possible substitution effect between canned sweet corn and other processed vegetables was obscured.

In view of the ratio between the estimated coefficient and the standard error of the coefficients, the estimates would appear to be acceptable ones.

Standard errors of the supply equation coefficients are large in relation to the estimated coefficients. This is due, at least in part, to intercorrelation as evidenced by the moment z_1z_3 being almost identical with the moment z_2z_3. The coefficients of the supply equation are obviously unacceptable.

LEAST-SQUARES ESTIMATE OF THE DEMAND EQUATION

The demand equation was estimated independently by least-squares, employing the same data used in estimating equation A-3. Notations are the same as equations A-1 and A-3. Variables are expressed in terms of first differences of logarithms for the same reason as in estimating equation A-3.

The estimated relationship is (logarithm notation omitted):

A-5 $$y_1 = -0.0091 - \underset{(0.2672)}{0.6423y_2} + \underset{(0.2402)}{0.4364z_1} + \underset{(0.2183)}{0.5812z_2}$$

$R^2 = 0.4975$

$R = 0.7053$ (significant at 1% level)

$S^2 = 0.0080$

$S = 0.0892$

In view of the standard errors involved, the income coefficients in A-5 and A-3 do not appear to differ significantly.

Table A-1. Per capita consumption of canned sweet corn and other processed vegetables, price of canned sweet corn, January 1 inventories of canned sweet corn, and real income. Calendar years, United States, 1925-55

Year	Per capita disappearance canned sweet corn	Price per 303 can* (in 1947-49 dollars)	Per capita income* (in 1947-49 dollars)	Per capita disappearance other processed vegetables†	January 1 inventories canned sweet corn*
	(pounds)	*(cents)*	*(dollars)*	*(pounds)*	*(pounds)*
1925	3.76	20.4	848	21.6	0.63
1926	4.42	18.9	861	21.3	1.50
1927	3.91	18.5	869	18.2	2.26
1928	3.73	19.0	891	18.9	0.94
1929	3.85	18.8	930	21.7	0.80
1930	4.12	18.6	846	23.9	0.80
1931	3.76	17.8	792	21.3	0.49
1932	3.36	15.8	668	18.4	1.76
1933	3.12	15.7	658	18.9	0.60
1934	2.90	17.5	719	20.1	0.93 (.18)‡
1935	3.52	18.7	782	22.3	0.52
1936	4.04	17.7	872	23.3	1.32
1937	3.87	18.2	897	25.6§	0.84
1938	4.01	16.7	839	27.0	2.32
1939	4.23	15.5	906	27.7	2.81
1940	4.41	15.4	962	30.1	1.62
1941	4.70	15.7	1,108	32.3	0.59
1948	4.91	16.7	1,245	35.4	3.52
1949	4.82	16.6	1,239	36.4	4.75
1950	5.15	15.0	1,322	39.8	5.67
1951	4.82	16.0	1,319	40.7	3.94
1952	4.78	16.6	1,332	41.3	3.41
1953	5.11	16.6	1,371	42.1	4.03
1954	5.15	15.8	1,365	41.5	4.47
1955	5.26	14.9	1,430	43.2	4.75

* Source: Unpublished material supplied by AMS, USDA.
† Source: *The Vegetable Situation*, AMS, USDA, October 1956.
‡ Includes distributors' stocks from 1934 on.
§ Includes frozen vegetables other than sweet corn from 1937 on.

Appendix B. Supply Elasticity Estimating Procedures

BIAS IN ESTIMATE OF SUPPLY FUNCTION DEVELOPED FROM HISTORICAL SERIES

Considerable historical information exists, even on a state basis, from which a "supply function" for sweet corn can be estimated. And a simplified model for estimating this "supply function" can be easily constructed. Processors announce contract price in the spring of the year. Farmers compare and weigh the announced price with the prices of competing farm crops in view of production cost. The price announced in year *t* modified by the price of competing crops and the production cost determines production in year *t*. From this information, a supply equation could be written. For example:

B-1 $$y_1 + c_1z_1 + c_2z_2 + c_3z_3 + c_4z_4 + c_5 = u$$

where

y_1 = quantity supplied in year *t* (planted acreage)
z_1 = contract price for sweet corn in year *t*
z_2 = index of prices received by farmers in year *t-1*
z_3 = index of prices paid by farmers in year *t-1*
z_4 = trend variable
c_5 = constant term
u = random disturbances

Quantity alone is determined in the supply equation, and single equation estimation of coefficients is applicable. But the estimates of coefficients in the equation are biased, and supply elasticity is more inelastic than the "true" elasticity. The bias lies in the observations. For, although the observation is a true representation of actual production and prices paid, it is modified by processor production activities and processor procurement activities.

In Part II, we saw that the processor restricts acreage when the announced contract price is high enough to bring forth more production than he desires (see page 36). When the announced price is too low, the processor undertakes or increases his own raw product production (see page 38).

The effects of the processor's procurement activities are demonstrated in figure B-1. Let $P_1Q'_1$ and $P_2Q'_2$ be two observations of price and quantity data in a time series. Let S S be the "true supply curve." Price P_1 is high; farmers are ready to supply Q_1 amount, substantially more production than the processor desires. Production is restricted by the processor's decision to Q'_1, reducing forthcoming supplies by Q'_1Q_1 amount.

Price P_2 is low and forthcoming supply from farmer-growers is only Q_2 amount. The processor obtains the desired production by producing Q'_2Q_2 amount of raw product with his own resources. Processor procurement activities limiting farmer-grower production over the higher price interval, and their raw product production activities over the lower price intervals, cause the observable supply function to rise at a steeper rate than the "true" function does. In other words, an estimation based on the observed points $P_1Q'_1$ and $P_2Q'_2$ would trace curve S′ S′, a less elastic curve than the "true" supply curve S S.

An appraisal of prospective sweet corn output in the Midwest based on historical time-series data alone would be misleading and of questionable validity.

AN ALTERNATIVE TO THE TIME SERIES ANALYSIS

Theoretically, the supply function for a product produced on multi-enterprise

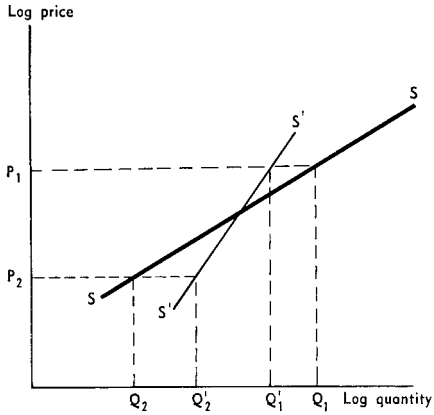

Fig. B-1. Illustration of the influence of processor procurement activities on observed historical data.

farms can be estimated from the production possibility curve.

For example, let us assume a firm produces two products, X and Y. Let the production possibility curve between X and Y be given by AB in Section A of figure B-2; let P_1P_1 represent the original price ratio. At price P_1 for commodity X, r_1 quantity will be produced. This gives one point, P_1r_1, on the farm supply function in Section B of figure B-2. Let the price of commodity X rise and the price of Y remain constant, the new price ratio becomes P_2P_2 (or $P_1P'_2$). A second point on the supply function for commodity X is thereby obtained. As the price of X is allowed to take different values, the supply curve S S for commodity X is traced in Section B, figure B-2. By similar reasoning, the cross supply for commodity X is, at the same time, traced in Section C, figure B-2.

The production possibility curve pictured in figure B-2 assumes a competitive relationship for farm resources between commodities X and Y over the entire range of the curve. The production possibility curve also may display complementary and supplementary relationships. The relationship is complementary if, by increasing the output of commodity X, the output of commodity Y also increases. The relationship is supplementary if the output of commodity X can be increased without affecting the output of commodity Y, holding resources constant.[1]

A crop involved in a complementary relationship is profitable to produce even at zero or negative prices. The effect of the complementary relationship on the supply function is thus output at very low prices. A crop involved in a supplementary relationship is profitable to produce even when price ratios are at extremes. The effect of the supplementary relationship on the supply function is output at relatively low prices and reduced responsiveness of output to price, causing the supply to be less elastic at low prices.

SUPPLY ELASTICITY BASED ON THE BUDGET APPROACH

Linear programming would appear to be a suitable technique for budgeting a farm supply function for sweet corn. Surveyed farmers in six select Midwest areas treat sweet corn similarly to field corn in the farm plan; the same rate or about the same rate of fertilization is followed, the same amount of weed spray is used per acre, the same cultural practices are employed. Stated differently, if farmers grew sweet corn at all, per acre inputs employed to produce the sweet corn were similar to those employed to produce the major, higher return crop enterprise, field corn. This suggests that individual growers tend to plan sweet corn output as though the production function were linear, and that opportunity costs of farm resources are the more important costs influencing farm output of sweet corn.

[1] These concepts of complementary and supplementary relations are from E. O. Heady, *Economics of Agricultural Production and Resource Use* (New York: Prentice-Hall, Inc., 1952).

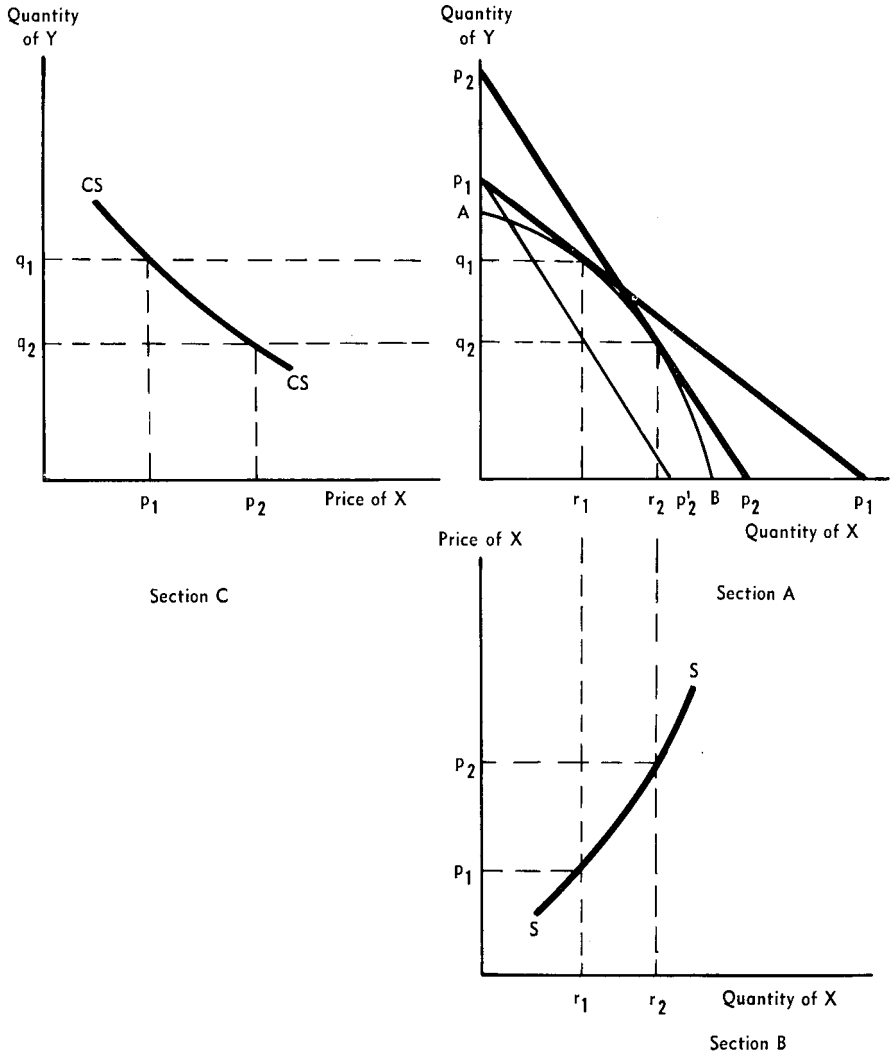

Fig. B-2. Illustration of how a supply function and a cross-supply function are obtained from the production possibility curve.

Linear production functions imply constant marginal rates of substitution between products and that output will remain constant over wide ranges in price ratio. This is consistent with surveyed farmers' statements as to how they would vary sweet corn acreage with changes in sweet corn prices. (See Part IV, page 64).

Generally, farmers in the survey grew more than one crop. Their comments on importance of crop rotation and distribution of risks over several crops, and on participation in govern-

ment acreage allotment programs, indicate that they tend to place maximum and minimum limits on acreage of individual crops which enter the production plan. The assumption that total cropland and labor available is limited in the family farm structure appears justifiable, at least in terms of annual farm production planning.

The production possibility curve for two crops, as visualized by a sweet corn grower in his production planning, appears to be as pictured graphically in figure B-3. The farmer will produce some quantity of both products at any non-zero or non-negative price ratio between the two alternatives. If the production possibility space is extended to cover three or more crops, one of the crops may enter the farm plan at a zero quantity.

Thus, it is possible to construct models to represent how farmer response in sweet corn output varies, as the price of sweet corn varies, that satisfy the assumptions of the linear programming technique.[2]

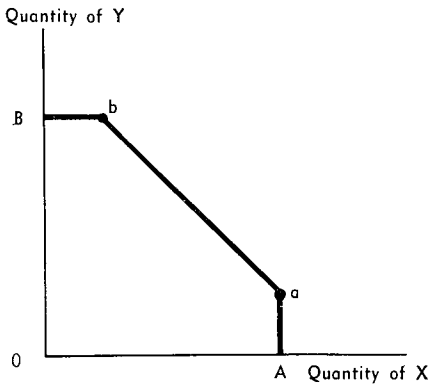

Fig B-3. Production possibility curve assumed in budgeted farm supply function.

Method

Farm situations representative of conditions found among surveyed sweet corn growers are constructed to describe several areas. These are east central Illinois; Columbia County, Wisconsin; Sibley County, Minnesota; Faribault County, Minnesota; and the three Minnesota areas taken as one. The farm sweet corn "supply function" is budgeted for the farm situation by the linear programming technique.

No typical farm as measured in acres, in available labor, or in livestock exists among surveyed growers. But typical combinations of labor per acre of cropland, when taken with labor per animal unit and with equipment setups, are found among farms included in the survey. In other words, resources in the production plans tend to be combined in a more or less homogeneous manner. Variations in cropland, livestock, and available labor between farms are "normalized" to the family-farm structural unit of a specified size in the representative farm situations.

Under the section, "An Alternative to the Time Series Analysis," describing the general approach, the cross-supply function for crop alternatives was shown to be obtained simultaneously with the supply function for sweet corn estimated from the production possibility curve. Secondary effects in other markets are thus implied in the development of the sweet corn supply function from this technique. However, sweet corn is of minor importance in the Midwest economy, and increases in sweet corn price or production would not result in important secondary effects that need to be considered simultaneously with the original increase in price or production.

The budgeted supply function assumes that the representative farmer

[2] These assumptions include: limited resources; production taking place in a finite series of processes; linearity and additivity of processes; and divisibility of processes and resources. (See J. N. Boles, "Linear Programming and Farm Management Analysis," *Journal of Farm Economics*, XXXVII, No. 1, February 1955, pp. 1-4.)

maximizes his income in a certainty environment.[3]

Possibility of error in estimates of supply grows out of the supply function developed in this approach being specified in the representative farm situation. The size of error depends upon how well budgeted farms represent real world conditions.

Methods for constructing and solving linear programming models are widely published, and mechanics are not discussed here.[4] Application of linear programming to estimating supply relations are discussed by Knudtson and Cochrane, and by Candler.[5]

The variable price programming method[6] is employed to obtain manually calculated solutions.

Representative Farm Situation

The representative farm on which sweet corn is grown in east central Illinois is dominated by cash crops. The representative farm on which sweet corn is grown in Columbia County, Wisconsin, is dominated by the dairy enterprise, and modified by the influence of a hog enterprise included in the farm plan as a market for farm-produced grains not consumed by the dairy enterprise.

Several farm situations are to be represented in Minnesota. Distribution of farms is multi-modal among dairy, dairy-hog, dairy-beef, dairy-beef-hog, beef-hog, and cash-crop types. A dairy-hog farm and a cash-crop farm are assumed to describe Minnesota production. Assumptions regarding these two representative farms are varied in order to represent different and important circumstances among surveyed growers.

Too little information exists for treating the capital resource as it affects sweet corn production. Processors are a source of capital, just as much as the farmer's owned capital or borrowed capital from some loan institution. But sweet corn is a capital-creating activity in the fall months. If fall capital can substitute for spring capital, or if a source of fall capital is important in the production plan, the problem of a negative sloping supply function for sweet corn arises.

For example, assume that a capital limitation governs the size of a field corn-hog production activity and the corn-hog activity yields the highest return to resources of all possible activities. Assume further that income from sweet corn in the fall creates capital for financing the corn-hog activity. An increase in fall capital then allows corn-hogs to increase. A decrease in fall capital would reduce corn-hogs.

Now let the price of sweet corn fall. Fall capital is reduced. The field corn acreage and number of hogs are reduced. The reduced field corn acreage allows sweet corn acreage to increase. Although expanding sweet corn acreage replaces fall capital to some extent, the drop in the price of sweet corn still would result in an *increase* in acreage of sweet corn, rather than in an expected decrease. In other words, the supply function under this condition, a distress condition, has a negative slope.

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[3] Net farm income on farms growing sweet corn varies as price varies, whether or not output varies. Also, less labor is often employed in sweet corn production. If a farmer increases production in response to a price rise for sweet corn, while decreasing output of some crop alternative, income increases and amount of labor for each unit of income (average per unit) falls. A change in farm income is argued to affect output. (See R. L. Clodius, "The Theory of the Kinked Output Path Response," *Journal of Farm Economics*, XXV, No. 3, August 1953, pp. 427-36; and G. W. Ladd, "Farm Income and the Supply of Agricultural Products," *Journal of Farm Economics*, XXXIX, No. 4, November 1957, pp. 865-80.

[4] Many issues of the *Journal of Farm Economics* of recent years contain papers on the application of linear programming to agricultural economics research.

[5] See Arvid C. Knudtson and Willard W. Cochrane, "A Supply Function for Flax at the Firm Level," *Journal of Farm Economics*, XL, No. 1, February 1958; and Wilfred Candler, "A Modified Simplex Solution for Linear Programming with Variable Prices," *Journal of Farm Economics*, XXXIX, No. 2, May 1957.

[6] Candler, *loc. cit.*

Evidence does not support a negatively sloping supply function. Response of surveyed farmers indicates a source of fall income to be reason for growing sweet corn and the individual farm supply function to be perfectly inelastic over wide price ranges. But no evidence indicated that these farmers would increase their sweet corn production when prices fell.

By reason of insufficient information, production capital is not assumed to be a limiting resource affecting the supply function for sweet corn. Because the processor will finance sweet corn production for the farmer, a capital limitation in the farm production plan encourages sweet corn production rather than hinders it. Also capital, as it affects the supply of sweet corn, becomes most important under distress conditions. For these reasons, it would appear that omission of the capital resource would not seriously modify the validity of the results as they apply to nondistress conditions.

Total labor quantity is one man, full-time, for 10-hour days—and one son, 17, furnishing 3 hours of labor per day during school term and 10 hours a day during vacation periods. On one cash-crop farm in Minnesota, labor is reduced to one full-time man equivalent, and on one dairy farm in Minnesota labor employed in various enterprises is increased about 7 percent. Labor is divided into the three seasonal groupings: spring, from April 20 to June 30; summer, from July 1 to September 30; and fall, from October 1 to November 10.

The cash-crop farms contain 220 acres of cropland, dairy-hog farms in Minnesota contain 140 acres of cropland, and the dairy-hog farm in Wisconsin contains 120 acres cropland. Assumed restrictions for cropland are based on census and survey data. Maximum acreage of intertilled row crops that can be grown without serious soil erosion is assumed to be from 65 to 75 percent of the cropland in Minnesota and Illinois, and 50 percent in Wisconsin. Restrictions regarding the amount of land in any crop are based on farmers' desires for diversification, farmers' attempts to control weeds through rotation, and farmers' attempts to rotate crops in general. Because sweet corn and field corn are similar crops, a total restriction of 60 percent of cropland is placed on total corn acreage.

Livestock on livestock farms is included only for dairy production and hog production. Scale of dairy production is assumed fixed and invariable regardless of the price of sweet corn. Decisions to produce dairy products are long-run decisions not likely to be affected by annual or biennial variation in crop prices. The farmer usually decides first the size and productive capacity of the dairy herd and the amount of feed to provide for it. The decision as to which combination of commodity outputs seems best suited to complete the balance of the farm plan then follows. The alternatives from which selection is made include field corn sold through hogs, oats sold through hogs, soybeans, and sweet corn. Hog production is thus allowed to vary in the livestock farm plan. Price of corn and oats sold through hogs is assumed to be the market price for corn and oats.

Prices employed in the estimates are state averages for 1954 to 1956. Yield data for field corn, oats, soybeans, and wheat in Minnesota are averages for 1954 to 1956, taken from Minnesota agricultural statistics published by the Minnesota State Federal Crop and Livestock Reporting Service. The area covered includes crop reporting districts 5, 8, and 9; this is the major sweet corn producing area in Minnesota. Sweet corn yields are state averages reported by the Crop Reporting Board of the USDA. (Processor selection of growers on the basis of yield modifies the ratio of yields causing some bias in results.) Yields in Columbia County, Wisconsin; Sibley County, Minnesota; Faribault County, Minnesota; and east central Illinois are

those stated by farmers to be the usual ones.

Labor and equipment input data are from *Planning Farms for Increased Profits* by P. R. Hasbargen and G. A. Pond, Station Bulletin 445, Agricultural Experiment Station, University of Minnesota. These data are similar to those obtained from the survey of sweet corn farmer-growers conducted during the summer of 1957. Seed, fertilizer, and other inputs are taken from survey schedules and from contracts obtained from processors. These data are summarized in tables B-1, B-2, and B-3.

Estimates of the "Supply Function"

The "supply function" obtained from linear programming solutions for a theoretical representative farm is shown in figure B-4. Sweet corn will enter the production plan with quantity Q_1 at a price 1 cent greater than P_1 and will remain at Q_1 quantity until the price rises to 1 cent less than P_2. At price P_2, quantity supplied can be Q_1, Q_2, or possibly some quantity between Q_1 and Q_2.[7] At a price 1 cent greater than P_2 but 1 cent less than P_3, quantity Q_2 is supplied. Price P_2 is a "border" price at which change in quantity supplied may occur, but the quantity supplied is undetermined among quantities ranging from Q_1 and Q_2. Similarly, P_1 and P_3 are also border prices and the "supply function" becomes undetermined at these prices.

The determined portion of the "supply function" for the individual representative farms described above is given in table B-4. The minimum price of sweet corn of interest is that which covers the cost of variable purchased inputs. The maximum price of interest is that at which maximum sweet corn production is reached. Alternative

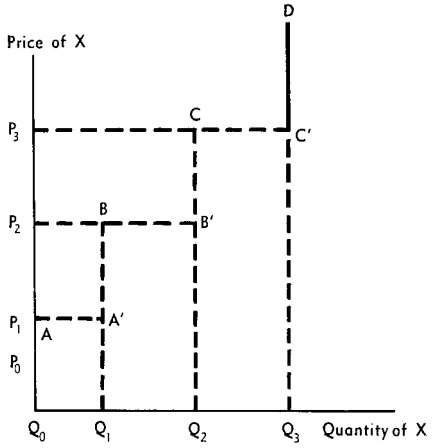

Fig. B-4. Theoretical sweet corn supply function for a representative farm.

prices are a zero minimum price and infinite maximum price.

The effect of the availability of resource on the supply function is shown among the cash crop farms in Minnesota. All three contain the same number of cropland acres. They differ only with respect to resources available. Cash-crop farm III is representative of cash-crop farms on which labor is a limiting resource. Maximum sweet corn production is reached at a substantially lower price than on cash-crop farms I and II. This comparison of representative farm III with representative farms I and II indicates how specification of the representative farm is a source of possible bias in the budgeted "supply function" and the estimate of the elasticity of supply. Unfortunately, no method of determining the bias with certainty is known. Based on the specification that the sweet corn enterprise can enter the farm plan to the extent of 40 percent of the cropland, however, the estimates

[7] The reason for the partly determined "supply function" lies in the mechanics of linear programming techniques. However, farmers' responses to survey questions support the possibility that the individual farm supply function is of this nature. In reply to survey questions asking how they would vary sweet corn acreage if the contract price was 1, 2, or 5 dollars different from this year's contract price, a number of farmers answered they did not know. But at the next high price, they would make a change. In other words an undetermined portion of the "supply function" was being considered.

Table B-1. Per acre input, output, cost, and return, crops produced on a representative farm, East Central Illinois

	Sweet corn	Field corn	Soybeans	Oats	Wheat
Seed					
quantity (pounds)	8	10	60	80	120
cost (dollars)	2.00	2.07	2.34	1.60	3.92
Fertilizer					
quantity (pounds)	200	225	.....	.....	350
cost (dollars)	6.30	6.41	.....	.....	7.45
Tractor					
quantity (hours)	4.69	5.32	4.92	3.70	4.05
cost @ $0.69/hr. (dollars)	3.24	3.67	3.39	2.55	2.79
Machinery					
quantity (hours)	4.69	5.32	4.92	3.70	4.05
cost @ $.25/hr. (dollars)	1.17	1.33	1.23	.92	1.01
Custom					
$2.50/ton harvest (dollars)	8.25	.....	.....	.....	.....
Storage, shell, haul (dollars)	.....	7.96	2.43	4.61	3.31
Total variable cost (dollars)	20.96	21.44	9.39	9.68	18.48
Yield (usual)	3.3	66.3	27.0	51.2	36.8
Price (av. 1954-56)	21.73	1.37	2.34	.64	1.96
Total returns	.....	90.83	63.18	32.77	72.13
Return less cost	.....	69.39	53.79	23.09	53.65

Table B-2. Per acre input, output, cost, and return, crops produced on a representative farm, Columbia County, Wisconsin

	Sweet corn	Field corn	Oats
Seed			
quantity (pounds)	8	10	88
cost (dollars)	2.40	2.05	1.84
Fertilizer (4-16-16)			
quantity (pounds)	250	250	100
cost (dollars)	8.00	8.00	3.20
Tractor			
quantity (hours)	3.94	5.32	3.70
cost @ $0.69/hr. (dollars)	2.72	3.67	2.55
Machinery			
quantity (hours)	3.94	5.32	3.70
cost @ $0.25/hr. (dollars)	0.98	1.33	0.92
Custom			
harvest and haul, $4.50/ton (dollars)	20.25	.....	.....
Store, haul and shell, and weed spray (dollars)	0.21	11.59	7.54
Total variable cost (dollars)	34.56	26.64	16.05
Yield (usual)	4.5	71.1	61.1
Price (av. 1954-56)	18.80	1.28	0.67
Total return	.....	91.00	40.94
Return less cost	.....	64.36	24.89

Table B-3. Per acre input, output, cost, and return, crops produced on representative Minnesota farms, Sibley County and Faribault County

	Sweet corn	Field corn	Soybeans	Oats	Wheat
Seed					
quantity (pounds)	8	10	60	96	60
cost (dollars)	2.40	2.05	2.24	1.83	2.15
Fertilizer (6-24-12)					
quantity (pounds)	200	200	.....	.....	.....
cost (dollars)	8.00	8.00	.....	.....	.....
Tractor					
quantity (hours)	3.94	5.32	4.92	3.70	3.70
cost @ $0.69/hr. (dollars)	2.72	3.67	3.39	2.55	2.55
Machinery					
quantity (hours)	3.94	5.32	4.92	3.70	3.70
cost @ $0.25/hr. (dollars)	.98	1.33	1.23	.92	.92
Custom harvest and haul, cost @ $4.50/ton (dollars)	16.65	.....	.....	.....	.....
Other storage, hauling, shelling (dollars)	.....	6.97	1.96	3.87	1.94
Total variable cost (dollars)	30.75	22.02	8.82	9.17	7.56
Minnesota					
Yield (av. 1954-56)	3.7	58.1	21.8	43.0	21.5
Price (av. 1954-56)	18.17	1.30	2.24	0.61	2.15
Total return	.....	75.53	48.83	26.23	46.23
Return less cost	.....	53.51	40.01	17.06	38.67
Sibley County					
Yield (usual)	4.1	78.1	25.7	60.7	29.6
Price (av. 1954-56)	18.17	1.30	2.24	0.61	2.15
Total return	.....	101.53	57.57	37.03	63.64
Return less cost	.....	79.51	48.75	27.86	56.08
Faribault County					
Yield (usual)	4.6	74.8	27.0	57.9	29.6
Price (av. 1954-56)	18.17	1.30	2.24	0.61	2.15
Total return	.....	97.24	60.48	35.32	63.64
Return less cost	.....	75.22	51.66	26.15	56.08

of the supply elasticity are believed to be greater than the true elasticity.

Estimate of the Supply Elasticity

Each of the five representative farms in Minnesota represents a number of farms displaying similar characteristics. The three cash-crop farms in Minnesota, however, display several similar characteristics as do the two dairy farms. Yet, the "supply function" for each representative farm is different because each represents a variation found between farms as they occur in the real world. These five farms form a family of representative farms. Their supply function has many more border prices than the single representative farm pictured in figure B-4, and any one indeterminate gap in output on the supply function tends to be less, relative to the output of all farms than for the single representative farm. As each variation between farms is more heavily represented by a representative farm, the number of representative farms would increase and the supply function for all farms would approach a smooth, continuous aggregate function.

Table B-4. Schedule of quantity of sweet corn supplied at various prices, representative farms, Illinois, Wisconsin, and Minnesota

Level	Price range		Quantity
	from	to	
	(dollars)		*(ton)*
ILLINOIS			
Cash Crop I			
1	6.35	15.64	0
2	15.66	22.64	72.6
3	22.66	27.37	145.2
4	27.39	.....	290.4
WISCONSIN			
Dairy Farm I			
1	.....	7.68	0
2	7.69	10.98	60.8
3	11.00	13.34	72.0
4	13.36	21.97	84.4
5	21.99	.....	213.8
MINNESOTA			
Dairy Farm I			
1	8.31	11.69	0
2	11.71	18.22	6.1
3	18.24	22.76	95.3
4	22.78	.....	207.2
MINNESOTA			
Dairy Farm II			
1	8.31	18.22	0
2	18.24	22.76	109.2
3	22.78	.....	207.2
MINNESOTA			
Cash Crop I			
1	8.31	12.91	0
2	12.93	19.11	40.7
3	19.13	22.76	162.8
4	22.78	.....	325.6
MINNESOTA			
Cash Crop II			
1	8.31	12.91	0
2	12.93	19.11	40.7
3	19.13	22.76	244.2
4	22.78	.....	325.6
MINNESOTA			
Cash Crop III			
1	8.31	15.57	0
2	15.59	15.59	151.3
3	15.61	19.18	162.8
4	19.20	19.21	171.4
5	19.23	.....	325.6
SIBLEY COUNTY, MINNESOTA			
Dairy Farm I			
1	7.50	12.73	0
2	12.75	17.55	6.7
3	17.57	26.88	105.6
4	26.90	.....	229.6

Table B-4. Schedule of quantity of sweet corn supplied at various prices, representative farms, Illinois, Wisconsin, and Minnesota (continued)

Level	Price range from	Price range to	Quantity
	(dollars)		*(ton)*
SIBLEY COUNTY, MINNESOTA *Cash Crop I*			
1	7.50	14.28	0
2	14.30	19.38	45.1
3	19.40	26.88	180.4
4	26.90	.....	360.8
FARIBAULT COUNTY, MINNESOTA *Dairy Farm I*			
1	6.68	11.04	0
2	11.06	16.66	7.5
3	16.68	23.03	118.4
4	23.05	.....	257.6
FARIBAULT COUNTY, MINNESOTA *Cash Crop I*			
1	6.68	12.36	0
2	12.38	17.91	50.6
3	17.93	23.03	202.4
4	23.05	.....	404.8

The elasticity of the aggregate "supply function" can be approximated from the "observed" points on the representative farm supply function listed in table B-4, by assuming that (1) production conditions are satisfactorily represented through appropriate weighing of representative farms, and (2) the number of farms represented approaches infinity.

The elasticity of the "supply function" for select areas in Minnesota, Wisconsin, and Illinois is estimated by simple logarithmic regression of quantity on price. Livestock farms are weighted in a ratio of two for one with cash-crop farms in Minnesota. The "b" values of estimated equations listed in table B-5 are the estimates of the elasticities.

Table B-5. Sweet corn supply estimating equations for representative farms, select Midwest areas

Log quantity by area and type of farm	"a" value constant term	"b" value for log price	Coefficient of correlation "r"
Illinois			
East central cash crop	−3.3143	+3.8407	.8190
Wisconsin			
Columbia County dairy farm	−1.0787	+2.5141	.6330
Minnesota			
all farms	−4.9212	+5.2034	.7908
Faribault County			
dairy I	−4.0411	+4.5272	.8780
cash crop I	−4.2422	+4.8929	.8586
Sibley County			
dairy I	−4.1125	+4.3692	.8717
cash crop I	−4.2939	+4.6912	.8501

Supply Elasticity Based on Survey Approach

The supply elasticities based on farm survey data are estimated by employing the following equation for obtaining point elasticity:[8]

$$\text{B-2} \quad \frac{\frac{\triangle Q}{Q}}{\frac{\triangle P}{P}} = \text{elasticity}$$

Quantity in the equation is the acreage of sweet corn farmers planted in 1957 and was obtained in the same place on the survey schedule as other information on cropland use.[9] Other entries in the equation were obtained from farmers by the following series of questions:

3.a. What was your contract price this year? (1957) P per ton. If the price was $1.00 higher this year, would you have contracted a larger sweet corn acreage? (check)

The quantities employed in the elasticity formulas are the respective area totals, and the prices are the average prices received by farmers in the respective areas. The elasticity for each price change is computed independently. Responses of surveyed farmers who were uncertain about their production plans at one of the specified price changes are excluded from the computation of the elasticity at that specified price but are included in the computation at the next higher specified price at which they were certain about their responses. Surveyed growers unable to furnish the desired price acreage information are excluded from computations.

Six estimates are obtained: three for price increases and three for price decreases. Only four are presented in table B-6, the other two not being meaningful in view of an incomplete sample. Where only those farmers currently growing sweet corn were included in the survey, no information is available for describing how farmers

Price Change	Yes	No	Don't Know	How Much
\$1.00 = $\triangle P_a$				= $\triangle Q_a$
\$2.00 = $\triangle P_b$				= $\triangle Q_b$
\$5.00 = $\triangle P_c$				= $\triangle Q_c$

b. What crop acreage would the increased sweet corn acreage come from? _____.

4. If the price was $1.00 less this year, would you have contracted a smaller sweet corn acreage? (check)

Price Change	Yes	No	Don't Know	How Much
\$1.00 = $\triangle P_d$				= $\triangle Q_d$
\$2.00 = $\triangle P_e$				= $\triangle Q_e$
\$5.00 = $\triangle P_f$				= $\triangle Q_f$

[8] The point elasticity equation appears more consistent with the wording and the order of survey questions than the arc elasticity equation.

[9] The acreage quantity for the 27 farms on which processors restricted acreage is adjusted with information from the following series of questions.

1. a. Were you able to contract for as much sweet corn acreage this year as you would like? Yes_____ No_____.
   b. If no, how many acres would you have liked to plant? _____.

Adjustment is necessary to place the 1957 acreage planted on the farm "supply function."

currently not producing sweet corn would respond to higher sweet corn prices. In other words, all sweet corn growers were not sampled for prospective response to price increases.

All sweet corn growers were sampled for response to price decreases, assuming, of course, a positive sloping supply curve. Due to the complete enumeration, estimates based on farmers' statements regarding their response to price decreases are more indicative of the area-wide sweet corn supply elasticity than estimates based on farmers' statements regarding their response to price increases. Where a single estimate of the sweet corn supply elasticity is developed in this study, a simple average of the three estimates for price decreases is used.

In addition to enumeration error and to problems with wording and ordering of survey questions, the size of the price spreads causes the estimates to be less elastic than the true elasticities. For example, the farmer might reduce his sweet corn acreage to zero in response to a 3-dollar price decrease. This change in acreage is enumerated at the 5-dollar price reduction; 2 dollars greater than the price which would cause the reduction in acreage to zero. The percent change in price is arbitrarily increased by the size of the price spread, thereby reducing the elasticity. (The percent change in the price

Table B-6. Percent change in sweet corn acreage associated with various percent changes in sweet corn price at specified price difference, and price-acreage elasticity, surveyed sweet corn growers, select Midwest areas, 1957

Area	Price change		Percent price change	Percent acreage change	Elasticity
Illinois					
East central	Increase	$1	5.61	2.68	.48
	Decrease	$1	5.61	18.32	3.27
		$2	11.22	67.55	6.02
		$5	28.06	90.77	3.23
	Average		.....	.....	4.17
Northern	Increase	$1	5.32	5.14	.97
	Decrease	$1	5.32	18.13	3.41
		$2	10.65	37.06	3.48
		$5	26.62	93.81	3.52
	Average		.....	.....	3.47
Wisconsin					
Columbia County	Increase	$1	5.58	0	0
	Decrease	$1	5.58	15.60	2.80
		$2	11.17	24.48	2.19
		$5	27.93	64.23	2.30
	Average		.....	.....	2.43
Minnesota					
Sibley County	Increase	$1	6.69	5.70	.85
	Decrease	$1	6.69	21.84	3.26
		$2	13.38	53.96	4.03
		$5	33.44	83.59	2.50
	Average		.....	.....	3.26
Faribault County	Increase	$1	6.30	7.92	1.26
	Decrease	$1	6.30	20.32	3.22
		$2	12.60	44.76	3.55
		$5	31.50	85.70	2.72
	Average		.....	.....	3.16
Southeastern	Increase	$1	5.30	17.24	3.25
	Decrease	$1	5.30	7.98	1.51
		$2	10.61	45.05	4.25
		$5	26.52	94.39	3.56
	Average		.....	.....	3.11

denominator of the elasticity fraction is increased, reducing the size of the fraction.)

Acreage Elasticity Based on Historical Series

Supply elasticities based on time-series data have been demonstrated to be less elastic than "true" elasticities. The purpose of obtaining this estimate is to substantiate findings obtained from the budget approach and the survey approach. Ohio was chosen because survey data collected by Ohio State University indicate processor raw-product production activities to be almost nil. One source of observation bias is eliminated, although other processor procurement activities still bias these observations.

The estimate of sweet corn acreage elasticity for Ohio is based on the assumption that the change in price from year *t-1* to year *t* determines the change in planted acreage from year *t-1* to year *t*. Where the contract price is known prior to seeding of the sweet corn crop, price in year *t* then determines planted acreage in year *t*, when other influencing factors remain constant. Statistical solution by first differences of logarithms tends to remove the effect of a declining trend in production. Elasticity so estimated is 1.28, indicating a 1 percent change in price associated with a 1.28-percent change in planted acreage.[10]

The data employed in the estimates are listed in table B-7.

Table B-7. Sweet corn for processing, planted acreage, and season average price received by growers Ohio, 1948-57

Year	Planted acreage	Price per ton
	(acres)	*(dollars)*
1948	21,000	23.10
1949	17,600	17.00
1950	9,800	14.60
1951	15,400	20.70
1952	15,200	21.90
1953	12,500	20.80
1954	8,400	17.90
1955	7,200	16.50

Source: Vegetables for Commercial Processing, 1918-50, Statistical Bulletin No. 132, BAE, USDA, June, 1953; and *Vegetables for Processing, 1949-55*, Statistical Bulletin No. 132, AMS, USDA, May, 1957.

[10] The relationship is $q = -.0397 + 1.2842_p$ where q = first difference of log planted acreage and p = first difference of log price. r = .8186 and the standard error of the "b" = .0751. This equation was chosen from four equations on the basis of the highest r.

Appendix C. Processing Firms and Their Activities

Table C-1. Sweet corn canning firms by products packed, 83 firms, select Midwest states, 1955-56

Products packed	Ohio*	Indiana*	Illinois†	Wisconsin‡	Minnesota†	Iowa†	Total§
				(number of firms)			
Sweet corn only	4	1	.....	2	4	3	14
Sweet corn, other vegetables	2	1	1	4	1	1	9
Sweet corn, other products	.....	.....	1	.....	.....	2	3
Sweet corn, other vegetables, other products	2	.....	.....	.....	.....	.....	2
Sweet corn and peas only	.....	1	2	18	7	2	24
Sweet corn and peas, other vegetables	3	2	3	9	.....	2	15
Sweet corn, peas, other vegetables, other products	.....	1	1	11	2	.....	17
No information on pack	.....	.....	2	.....	.....	2	4
Total	11	6	10	44	14	12	83

* From survey of 32 sweet corn processing plants in Ohio, Indiana, and Wisconsin conducted by Ohio State University, 1955-56.

† From mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa conducted by University of Minnesota, fall, 1956.

‡ From the Wisconsin State Canners Association.

§ Double counting for firms with plants in several states has been eliminated, so the total does not necessarily equal the sum of the row.

Table C-2. Sweet corn canning firms by advertising of the canned product and by size of the firms, 27 firms, Illinois, Minnesota, and Iowa, 1956*

Firm size as indicated by cases of sweet corn canned	Advertising of product				
	No advertising	Allowance to buyers only	Consumer advertising	Other	Total
			(number of firms)		
Less than 100,000	6	2	.....	.....	8
100,000 to 249,999	6	.....	1	1†	8
250,000 and over	.....	1	10	.....	11
Total	12	3	11	1	27

* From mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa conducted by the University of Minnesota, fall, 1956.

† Does some consumer advertising spasmodically.

Table C-3. Sweet corn canning firms by specialization in grade of sweet corn canned and by size of firm, 39 firms, Ohio, Indiana, Illinois, Minnesota, and Iowa, 1955-56*

Firm size as indicated by cases of sweet corn canned	Grade				
	Fancy	Fancy and extra standard	Extra standard	No reply	Total
			(number of firms)		
Less than 100,000	5	5	8	1	19
100,000 to 249,999	6	2	1	.....	9
250,000 and over	9	1	.....	1	11
Total	20	8	9	2	39

* Data for Ohio and Indiana are taken from a survey of 32 sweet corn processing plants in Ohio, Indiana, and Wisconsin conducted by Ohio State University, 1955-56. Data for Illinois, Minnesota, and Iowa come from a mail survey of sweet corn processing plants in those states conducted by the University of Minnesota, fall, 1956.

Table C-4. Sweet corn canning firms by percent of finished product sold buyers label and by size of firm, 27 firms, Illinois, Minnesota, and Iowa, 1956*

Firm size as indicated by cases of sweet corn canned	Percent sold buyers label					
	Over 75%	50 to 75%	25 to 49%	Less than 25%	No reply	Total
	(number of firms)					
Less than 100,000	2	4	.....	2	.....	8
100,000 to 249,999	6	.....	.....	2	.....	8
250,000 and over	.....	2	1	6	2†	11
Total	8	6	1	10	2	27

* From mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa conducted by the University of Minnesota, fall, 1956.

† Both canners not reporting were of the 4 national brand advertising companies—Green Giant Co.; California Packing Corp.; Libby, McNeill and Libby, Inc.; and Stokely-Van Camp.

Table C-5. Sweet corn canning firms in Illinois, Minnesota, and Iowa by response to survey questions 14b and 14c, selection of growers, 1956*

Item	Replies
14b. On what basis do you select your regular growers? Please check.	Number
Past yield performance	22
By climatic and soil area for reducing risk of crop failure due to weather risk	12
Size of acreage contracted	11
Quality of sweet corn produced	17
Any farmer who wishes to grow sweet corn for processing and who gets yields of 1.5 tons per acre or better	3
Grower cooperation	1
Nearness to plant	1
Co-op. members	2
Number of replies	69†
14c. On what basis do you select new growers?	
Soil type to obtain higher yields	23
Size of acreage contracted	17
Climatic area to obtain higher yields	4
Climatic and soil area so that the risk of crop failure due to weather conditions can be reduced	10
Any farmer who wishes to grow sweet corn for processing	3
Co-op. members	2
Grower cooperation	1
Nearness to plant	1
Best farmers	1
Some years any farmer	2
Number of replies	64†

* From mail survey of sweet corn processing firms in Illinois, Minnesota, and Iowa conducted by the University of Minnesota, fall, 1956. † Most firms listed more than one reason.

Table C-6. Sweet corn canning firms by number of styles and size of firm, 83 firms, Ohio, Illinois, Indiana, Wisconsin, Minnesota, and Iowa, 1955-56*

Firm size as indicated by cases of sweet corn canned	Number of styles					
	1	2	3	4	No reply	Total
	(number of firms)					
Less than 100,000	24	14	2	1	.....	41
100,000 to 249,999	8	11	.....	2	.....	21
250,000 and over	1	8	1	7	.....	17
No reply	.....	.....	.....	.....	4	4
Total	33	33	3	10	4	83

* Data for Ohio and Indiana from a survey of 32 plants by Ohio State University, 1955-56; for Illinois, Minnesota, and Iowa from a mail survey by the University of Minnesota, fall, 1956; for Wisconsin from the Wisconsin State Canners Association.

Appendix D. Farm Production Data

Table D-1. Equations determining yield of sweet corn required for equal net per acre returns with field corn, soybeans, and oats as yields of field corn, soybeans, and oats vary, six select areas, Midwest, 1954-56

Area	Sweet corn	Field corn	Soybeans	Oats
Illinois				
East central	X_{se}	$= 1.2489 + .0508X_{fc}$	$= 1.0436 + .1079X_{sb}$	$= .4630 + .0387X_{o}$
Northern	X_{se}	$= 1.2642 + .0571X_{fc}$	.....	$= .2005 + .0387X_{o}$
Wisconsin				
Columbia County	X_{se}	$= -1.0153 + .0958X_{fc}$	.....	$= -.2605 + .0483X_{o}$
Minnesota				
Sibley County	X_{se}	$= -.1854 + .0944X_{fc}$	$= -1.5178 + .2430X_{sb}$	$= .1835 + .0452X_{o}$
Faribault County	X_{se}	$= -1.3214 + .1107X_{fc}$	$= -1.5979 + .2401X_{sb}$	$= -.0644 + .0408X_{o}$
Southeastern	X_{se}	$= -1.4503 + .1080X_{fc}$	$= -1.1875 + .2122X_{sb}$	$= -.3890 + .0505X_{o}$

Example: What yield of sweet corn is required to give a per acre net income equal to the income from a 24 bushel yield of soybeans in southeastern Minnesota?

Answer: $X_{se} = -1.1875 + .2122X_{sb}$

$X_{se} = 3.9$

Roughly a 3.9-ton yield of sweet corn is required for equal per acre income with soybeans under yields farmers felt usual and under 1954-56 prices.

Table D-2. Regression equations expressing the relationship between crop yields and per acre "usual" returns after costs for paired crops, six select Midwest areas, 1954-56*

Dollar returns determined, area and crop pairs	Coefficient of correlation "r"	"a" value	"b" value of yield	Standard error estimate "Z"
Illinois				
East central				
Field corn	.9081	—10.6517	1.0510	4.5813
Sweet corn	.8904	—36.4879	20.6873	5.1634
Soybeans	.8226	—15.4715	2.2410	5.2182
Sweet corn	.8732	—37.1360	20.7603	5.5713
Oats	.8294	—22.7708	.7643	5.1434
Sweet corn	.9333	—31.9046	19.7290	4.4323
Northern				
Field corn	.8441	— 7.2376	1.0486	5.1462
Sweet corn	.8204	—30.4628	18.3716	5.2981
Soybeans	.....	.....	.....	.....
Sweet corn	.....	.....	.....	.....
Oats	.8471	—21.3854	.6544	4.4639
Sweet corn	.7852	—24.7746	16.9042	5.9963
Wisconsin				
Columbia County				
Field corn	.9245	—31.7285	1.2226	7.7921
Sweet corn	.7696	—18.7698	12.7631	11.4864
Soybeans	.....	.....	.....	.....
Sweet corn	.....	.....	.....	.....
Oats	.8063	—25.3572	.6460	5.1088
Sweet corn	.7648	—21.8732	13.3726	11.3754
Minnesota				
Sibley County				
Field corn	.7889	—21.7483	1.0892	7.9431
Sweet corn	.7696	—19.6088	11.5430	5.8881
Soybeans	.8522	—27.7091	2.3717	6.0006
Sweet corn	.7081	—12.8959	9.7595	6.4143
Oats	.7378	—15.3427	.4813	4.9969
Sweet corn	.7653	—17.2963	10.6519	6.2781
Faribault County				
Field corn	.9334	—29.4847	1.2752	6.2848
Sweet corn	.8895	—14.2603	11.5216	5.3642
Soybeans	.9399	—33.7456	2.7636	4.5455
Sweet corn	.8808	—15.3517	11.5116	5.7081
Oats	.6449	—10.6525	.4281	6.8199
Sweet corn	.8423	— 9.9768	10.4909	6.7972
Southeastern Minnesota				
Field corn	.9488	—27.5176	1.1965	5.1476
Sweet corn	.8254	—11.4445	11.0829	5.3075
Soybeans	.9232	—26.1531	2.4411	5.8183
Sweet corn	.8445	—12.4934	11.5029	5.5653
Oats	.7866	—18.3561	.5995	4.7420
Sweet corn	.8200	—13.7384	11.8695	5.8735

* A sweet corn regression equation was computed for each crop comparison in order to include only the farms growing both crops. Difference between sweet corn regressions within each area result from different permissive farms.

Table D-3. Crop alternatives to sweet corn: Percentage distribution and number of responses to survey question 1d, Part III: "In the event that you were unable to contract any sweet corn at all this year, what crop would you have grown in place of sweet corn?" (first and second choice),* select areas, Midwest, 1957†

Crop	East central Illinois	Northern Illinois	Columbia County Wisconsin	Sibley County Minnesota	Faribault County Minnesota	Southeast Minnesota	All Areas
				(percent)			
Field corn	20	55	59	34	25	25	35
Soybeans	76	39	7	53	57	50	49
Small grain	4	3	20	11	14	12	11
Peas	.....	.....	5	2	2	3	2
Hay	.....	.....	2	.....	.....	5	1
Sugar beets	.....	.....	.....	.....	2	.....	‡
No response	.....	3	7	.....	.....	5	2
Total	100	100	100	100	100	100	100
				(number)			
Total replies	46	36	41	47	49	40	259
Number of growers stating second choice	9	5	7	16	13	7	57

* Second choice is included because surveyed growers were often indifferent or undecided about the crop alternatives.

† From survey question series:

PART III: ALTERNATIVE CROPS

1. a. How many years have you been growing sweet corn?_____
   b. Have you increased or decreased your acreage of sweet corn in the last five years? (check) Increased___ Decreased___ No change___
   Why did you make this change?_____
   c. What crops did you decrease or increase in order to increase or decrease your sweet corn acreage?_____
   d. In the event that you had been unable to contract any sweet corn at all this year, what crop would you have grown in place of sweet corn? 1._____ 2._____
   e. Why do you prefer sweet corn to this (these) crop?
   1._____ 2._____ 3._____

‡ Less than one-half percent.

Table D-4. Crop alternatives to sweet corn: Percentage distribution and number of responses to survey question 3c, Part IV: "If the price of sweet corn should rise or receive a guarantee of a higher yield and you increased your sweet corn acreage, what crop would you decrease?" Select areas, Midwest, 1957

Crop	East central Illinois	Northern Illinois	Columbia County Wisconsin	Sibley County Minnesota	Faribault County Minnesota	Southeast Minnesota	Total
			(percent of responding growers)				
Field corn	4	62	50	17	28	23	31
Soybeans	91	24	.....	44	52	39	43
Small grain	5	5	30	31	20	23	18
Peas	.....	9	10	4	.....	15	5
Hay	.....	.....	10	.....	.....	.....	2
All crops	.....	.....	.....	4	.....	.....	1
Total	100	100	100	100	100	100	100
			(number of responding growers)				
Responding growers	22	21	20	23	25	13	124

Table D-5. Crop alternatives to sweet corn: Percentage distribution and number of responses to question 1c, Part III: "What crops did you decrease or increase in order to increase or decrease your sweet corn acreage?" Select areas, Midwest, 1957

Crop	East central Illinois	Northern Illinois	Columbia County Wisconsin	Sibley County Minnesota	Faribault County Minnesota	Southeast Minnesota	All areas
			(percent of responding growers)				
Field corn	50	92	53	37	33	48	50
Soybeans	42	.....	6	42	42	14	24
Small grain	.....	.....	23	11	25	24	15
Peas	.....	.....	.....	5	.....	5	2
Hay	8	8	18	5	.....	9	9
Total	100	100	100	100	100	100	100
			(number of responding growers)				
Responding growers	12	12	17	19	12	21	93

Table D-6. Advantages of sweet corn enterprise: Percentage of surveyed growers responding Yes to Question 3, Part III: "Some farmers have said the following advantages were important on their particular farms. Are any of them important enough in your farm setup to influence the number of acres of sweet corn you grow?" Select areas, Midwest, 1957*

Area	Labor distribution	Improve crop rotation	Land better adapted to sweet corn	Market problem with other crops	Acreage restricted (field corn)	Higher returns from sweet corn	Sure price and market for sweet corn	Number of surveyed growers
				(percent responding "yes")				
East central Illinois	65	84	8	6	25	3	9	37
Northern Illinois	74	52	16	32	36	23	37	31
Columbia County, Wisconsin	52	42	18	15	26	7	53	34
Sibley County, Minnesota	81	97	6	3	34	13	39	32
Faribault County, Minnesota	83	97	24	6	22	13	38	36
Southeastern Minnesota	88	72	21	9	41	68	42	33
All areas	74	74	16	12	30	20	43	203

* From survey question series:

2. Often there is some advantage that sweet corn has in a farm setup that other crops do not have. In your farm setup, is there such a feature? (explain)

3. Some farmers have said the following advantages were important on their particular farms. Are any of them important enough in your farm setup to influence the number of acres of sweet corn you grow?

Table D-7. Number of surveyed sweet corn growers increasing or decreasing sweet corn acreage at specified price differentials from the 1957 contract price, select areas, Midwest, 1957*

Price differential	Illinois		Wisconsin	Minnesota		
	East central	Northern	Columbia County	Sibley County	Faribault County	South-eastern
			(number of farmers)			
Increase						
1 dollar	3	2	0	6	3	2
2 dollars	6	5	3	9	5	2
5 dollars	14	11	14	14	11	6
No change at 5 dollars	6	7	9	1	4	4
Uncertain at 5 dollars	5	3	1	0	4	2
Other†	3	3	7	2	9	17
Total	37	31	34	32	36	33
Decrease						
1 dollar	9	11	4	11	9	4
2 dollars	15	8	5	8	9	10
5 dollars	6	9	13	10	11	15
No change at 5 dollars	3	2	6	2	4	0
Uncertain at 5 dollars	2	1	0	0	0	1
Other†	2	0	6	1	3	3
Total	37	31	34	32	36	33

* Response to survey question, Part IV: 3) What was your contract price this year? _____per ton. If the price was ($1.00, $2.00, or $5.00) higher this year, would you have contracted a larger sweet corn acreage? and 4) If the price was $1.00 ($2.00 or $5.00) less this year, would you have contracted a smaller sweet corn acreage?

† No reply to the question or the question did not apply due to limitations imposed by processor.

Table D-8. Federal government farm programs and sweet corn acreage: Compliance with field corn acreage allotment and indicated change in sweet corn acreage accompanying removal of field corn acreage restrictions, select areas, Midwest, 1957*

Area		Do you comply with your acreage allotment for field corn? (Number answering, Yes)	If you could grow all the field corn you wanted to and still stay in the support program would you continue to grow sweet corn?			Total all surveyed growers
			Yes	Don't know	No	
Illinois						
East central	Number	*18*	26	4	7	37
	Sweet corn acreage		669	96	153	918
Northern	Number	*14*	22	4	5	31
	Sweet corn acreage		1,000	121	196	1,317
Wisconsin						
Columbia County	Number	*16*	22	2	8	32
	Sweet corn acreage		364	60	178	602
Minnesota						
Sibley County	Number	*11*	21	3	8	32
	Sweet corn acreage		613	53	238	904
Faribault County	Number	*13*	26	3	7	36
	Sweet corn acreage		718	78	126	922
Southeastern	Number	*18*	25	2	6	33
	Sweet corn acreage		983	29	159	1,206
TOTAL						
All areas	Number	*90*	142	18	41	201
	Sweet corn acreage		4,382	437	1,050	5,869
Percent of total	Farms	*45*	71	9	20	100
	Sweet corn		75	7	18	100

*From survey question series:

5. a. How about the government field corn price support program? Do you have an acreage allotment for field corn? Yes_____ No_____ Do you comply with it? Yes_____ No_____.

   d. If you could grow all the field corn you wanted to and still stay in the support program, would you continue to grow sweet corn? Yes_____ No_____ Don't know_____.

Table D-9. Federal government farm programs and sweet corn acreage: Sweet corn and field corn acreage by indicated change in sweet corn acreage accompanying a change in federal field corn acreage allotment, select areas, Midwest, 1957*

Area		If your field corn acreage allotment were increased would you decrease your sweet corn acreage?			If yes, by a like amount?			Total, all surveyed growers
		Yes	Don't know	No	Yes	Don't know	No	
Illinois								
East central	Number	6	.....	13	3	2	1	37
	Sweet corn acreage	192	.....	.....	126	51	15	918
	Field corn acreage	481	.....	.....	299	147	35	3,166
Northern	Number	5	1	7	5	.....	.....	31
	Sweet corn acreage	251	13	.....	251	.....	.....	1,317
	Field corn acreage	300	.....	.....	300	.....	.....	3,043
Wisconsin								
Columbia County	Number	8	.....	8	6	2	.....	32
	Sweet corn acreage	215	.....	.....	191	24	.....	602
	Field corn acreage	310	.....	.....	235	75	.....	1,224
Minnesota								
Sibley County	Number	8	.....	3	5	2	1	32
	Sweet corn acreage	164	.....	.....	119	20	25	904
	Field corn acreage	362	.....	.....	261	35	66	2,021
Faribault County	Number	6	.....	7	5	.....	1	36
	Sweet corn acreage	189	.....	.....	169	.....	20	922
	Field corn acreage	268	.....	.....	248	.....	20	2,988
Southeastern	Number	9	.....	9	7	1	1	33
	Sweet corn acreage	294	.....	.....	169	30	95	1,206
	Field corn acreage	355	.....	.....	245	63	47	1,820
TOTAL								
All areas	Number	42	1	47	31	7	4	201
	Sweet corn acreage	1,305	13	.....	1,025	125	155	5,869
	Field corn acreage	2,076	.....	.....	1,588	320	168	14,262
Percent of total	Farms	20	0	24	15	3	2	100
	Sweet corn acreage	22	0	.....	17	2	3	100

* From survey question series:

5. a. How about the government field corn price support program? Do you have an acreage allotment for field corn? Yes_____ No_____ Do you comply with it? Yes_____ No_____

   b. (If a is yes) If your allotment of field corn were increased and more land could be planted to field corn, would you decrease your sweet corn acreage? Yes_____ No_____ Don't know_____.

   (If b is yes) By a like amount? Yes_____ No_____ Don't know_____.

Appendix E. Transportation Costs of Canned Sweet Corn

Table E-1. Rail freight charge per 100 pounds for shipping canned sweet corn from major canning centers to major consuming centers, including shipping point and destination point service charges, 1957*

	Destination								
	East		Southeast		Southwest	West			Midwest
Shipping point	New York, N.Y.	Boston, Mass.	Columbia, S.C.	Atlanta, Ga.	Ft. Worth, Texas	Denver, Colo.	Salt Lake City, Utah	San Francisco, California	Chicago, Ill.
East									
Lewiston, Maine	0.43	0.24	.....	.....	.....	.....	.....	.....	0.95
Baltimore, Md.	0.28	0.48	0.57	0.71	1.51	.....	.....	.....	0.77
Rochester, N.Y.	0.40	0.46	.....	.....	.....	.....	.....	.....	0.61
Midwest									
Columbus, Ohio	0.64	0.78	0.64	0.61	1.26	1.19	.....	.....	0.36
Indianapolis, Ind.	0.78	0.85	0.69	0.58	1.15	1.10	.....	.....	0.27
Des Moines, Iowa	1.00	1.04	1.12	1.00	0.86	0.84	1.79	1.67	0.45
Madison, Wis.	0.87	0.91	0.87	0.80	1.02	1.11	1.79	1.67	0.22
Mankato, Minn.	1.01	1.04	1.18	1.09	1.00	0.91	1.69	1.67	0.53
West									
Boise, Idaho	1.94	.....	.....	.....	1.67	1.35	0.72	0.82	1.67
Yakima, Wash.	1.94	.....	.....	.....	1.67	1.35	0.72	0.82	1.67

* 60,000 pound carloads. Information from freight rate service division.

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