Staff Paper Series

STAFF PAPER P74-20 SEPTEMBER 1974

THE DEVELOPMENT OF MINNESOTA AGRICULTURE, 1880-1970: A STUDY OF PRODUCTIVITY CHANGE

by
Joseph C. Fitzharris

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture
St. Paul, Minnesota 55101

Staff Paper P74-20 September 1974

The Development of Minnesota Agriculture, 1880-1970: A Study of Productivity Change

Joseph C. Fitzharris

THE DEVELOPMENT OF MINNESOTA AGRICULTURE, 1880-1970: A STUDY OF PRODUCTIVITY CHANGE*

Joseph C. Fitzharris

Between 1880 and 1970, Minnesota's agricultural sector grew considerably. The value of agricultural production (in constant 1950 dollars) increased by about 650 percent. Land in farms and improved acreage increased by 115 and 212 percent respectively. Labor inputs also increased, although at a lower rate. During this period, labor efficiency improved; fewer workers produced larger amounts of crop and livestock products. Both labor and land productivity rose, while the capital investment in land and buildings per worker has remained almost constant (in 1950 dollars).

Much of the growth in agricultural production can be explained by more frequent use of mechanical and biological innovations. Tractors and other motive power substituted for human (and animal) power are examples of mechanical innovation. The use of fertilizers and pesticides, and fertilizer-responsive, disease-resistant crops are examples of the biological innovations. Labor and land productivity increases can largely be explained by these same factors. Such an explanation involves the use of appropriate analytical tools and a solid knowledge of the historical record of Minnesota agriculture between 1880 and 1970.

---

* Mr. Fitzharris is Instructor in the College of St. Thomas Department of History. The research on which this paper is based was supported by a grant from the Rockefeller Foundation to the University of Minnesota Economic Development Center. This paper is a part of a larger study by J. C. Fitzharris, Willis L. Peterson, and Vernon W. Ruttan entitled "Technology, Institutions and Development: Minnesota Agriculture, 1880-1970", funded by the same Rockefeller Foundation grant. University of Minnesota Department of Agricultural and Applied Economics Staff Paper P74-20. Presented to the Ninth Annual Northern Great Plains History Conference, Mankato, Minnesota, 17-19 October 1974.

PRODUCTIVITY CHANGE

Productivity change is the increased efficiency in the use of scarce factors of production. Labor and land productivity measure the efficiency of labor and land inputs in the process of producing agricultural goods. Productivity increases are important to farmers because the more efficiently resource inputs are utilized, the more likely increased revenues and/or decreased costs become. Less efficient farmers are increasingly unable to compete with their more efficient neighbors. Similarly, the agricultural sector of a state or national economy must be efficient or its competitor states or nations will reduce its viability in national or international markets.

Measures of Productivity:

The basic measure of productivity is the amount of output produced per worker.[1] Refinements of the basic measure, for example, the use of net change in output per net change in factor input measures the changes in productivity between two years. Alternatively, changes in productivity can be measured by determining how many workers would have been necessary to produce this year's output using last year's technology (represented by its output per worker ratio.)[2]

Labor productivity can be divided into two components. Growth in land (acres) per worker (A/L) and growth in output per acre (Y/A) together

---

[1] Output per worker is measured by Y/L, where Y = output and L = labor.

[2] Respectively: $(Y_2-Y_1)/(L_2-L_1) = dY/dL$; $(Y_1/L_1) \cdot Y_2 = L_2'$, the amount of labor necessary to produce Y_2 using year 1 technology.

form the output per worker (Y/L) measure.[3] Using rate of change data, a slightly different form of the relationship is required, but the normal relationship is multiplicative:

$$\frac{Y}{L} = \frac{A}{L} \cdot \frac{Y}{A}$$

Land area per worker (A/L) is semi-autonomous of output per acre (Y/A), and because of this feature, the direction of innovation in the agricultural sector can be determined. If innovation is labor-saving (making labor more efficient, raising the acreage a worker can utilize in the same amount of time), the acreage per worker (A/L) ratio will rise. This change reflects increased scarcity of labor; the price of labor has risen relative to the price of land. Similarly, when the innovation is land-saving (raising the amount of output per acre input), the price of land has risen relative to the price of labor.

Labor-saving innovations are mechanical. Tractors, combines, motor trucks, electric motors, milking machines, etc. are of this type. They all allow a worker to produce more wheat, milk, etc. with the same amount of time and effort. Machine power is substituted for human power.

Land-saving innovations are biological. Fertilizers, pesticides, disease-resistant crops, and the like, are examples of biological innovation. They allow increased production with the same amounts of land surface input. Solar power is more efficiently converted to plant (and animal) nutrients.

---

3 Yujiro Hayami and Vernon W. Ruttan, Agricultural Development: An International Perspective (Baltimore: The Johns Hopkins Press, 1971), pp. 115-122.

Implications of Productivity Change:

Rising productivity, either of land, labor, or both, is important. Productivity increases imply the more efficient use of resources. Since resources are scarce and finite, more efficient use means lower cost production. Lower cost production, given the prevailing relative prices of resource inputs, should result in lower prices to consumer for agricultural products. The largest beneficiary of increased productivity in agriculture is not the farmer, but rather the consumer. The farmer benefits from lowered costs of production relative to gross revenues. The consumer, who pays for agricultural research in the private and public sectors, benefits by having to pay less for more, better quality foods. The result is a more efficient allocation of resources within the entire economy.

MINNESOTA AGRICULTURE, 1880-1970

The production of agricultural goods in Minnesota between 1880 and 1970 is a large, complex story. Centering on productivity change simplifies the story and makes it manageable. Analysis of the more efficient use of resources by the agricultural sector necessitates an overview of the trends and magnitudes in Minnesota agriculture. Output levels and changes, together with the various inputs utilized by Minnesota farmers form the basic features of the historical record. In addition, the data necessary to the analysis of productivity change is assembled and discussed within the framework of the historical background.

TABLE 1: PRODUCTION AND PRODUCTION TRENDS IN MINNESOTA AGRICULTURE, 1880-1970

YEAR	CURRENT DOLLAR VALUE OF PRODUCTION ($ 000)	CONSTANT DOLLAR VALUE OF PRODUCTION[a] ($ 000)	INDEX OF PRODUCTION[b] (1950=100)	RATE OF CHANGE OF PRODUCTION[c]
1880	$ 84,176.5	$ 256,642.2	5.8	
1890	131,276.2	380,510.7	9.1	50.02%
1900	163,177.8	572,553.7	11.3	50.47
1910	291,215.8	859,043.7	20.1	50.04
1920	558,807.2	1,091,420.3	38.6	27.05
1930	453,229.7	1,218,359.4	31.3	41.8
1940	739,103.4	1,380,488.7	51.0	13.3
1950	1,449,198.9	1,408,762.0	100.0	2.1
1960	1,240,438.6	1,656,126.3	85.6	17.56
1970	1,956,661.3	1,920,177.9	135.0	15.9

SOURCE: Column 1 from sources listed in appendix, p. 23; other columns calculated by author. Column 2 is column 1 adjusted by the price index, which is listed in table 6 in the appendix, p. 24. Column 3 is calculated from the data in table 5 using the method listed in the appendix, p. 21. Column 4 is calculated from column 2 using the formula: (year 2 - year 1)/year 1.

[a]Constant 1950 dollars [b]1950 = 100, applies to column 1

[c]applies to column 2

Output Trends:

The value of the commercial vegetables, crops, and livestock (in constant 1950 dollars) has been estimated. Five year averages centered on the reported year were used. Because of deficiencies in the data series, the production of eggs and dairy products were not included. Production, rather than final sales to markets, was used to include home consumption. These omissions result in an under-estimated value of production series.[4]

Between 1880 and 1970, the value of commercial vegetables and fruit, crops, and livestock increased by 650 percent. During these years, commercial vegetables and fruits became somewhat more important, rising from negligible proportions of total production to two and one-half percent of output. Over the period, crops declined in importance and livestock became slightly more important. Cattle, both feeder and dairy cattle, formed a larger proportion of the livestock on farms over the ninety years. Wheat had been the most important crop in 1880; by 1970, corn replaced wheat as the leading crop. Soybeans, first reported in Minnesota Agricultural Statistics in the 1930's formed twenty-three percent of the value of crop production in 1970.

Input Trends:

With the exception of the 1900-1910 decade of slow growth, the numbers of farms expanded rapidly between 1880 and 1940, then declined. Acreage per farm increased rapidly to 1910, then declined to 1940. After 1940, farm size again increased rapidly, reaching 260 acres per farm in 1970. Improved

---

4 See the appendix for the data and procedures used in constructing this value of production series.

TABLE 2: FARMS AND ACREAGE IN MINNESOTA AGRICULTURE, 1880 - 1970

YEAR	FARMS	TOTAL ACREAGE (000)	IMPROVED ACREAGE (000)
1880	92,386	13,403	7,247
1890	116,851	18,664	11,128
1900	154,659	26,248	18,443
1910	156,137	27,676	19,644
1920	178,478	30,222	21,482
1930	185,255	30,193	27,739
1940	197,351	32,607	21,899
1950	179,101	32,883	29,988
1959	145,662	30,796	22,083
1969	110,747	28,845	22,648

SOURCE: United States Bureau of the Census, Census of Agriculture, 1880-1970.

NOTE: The ratio between improved acreage and total acreage can be calculated by dividing column (3) by column (2).

acreage as a proportion of total acreage increased from 1880 to 1930, then declined. The average ratio of improved acreage to total acreage appears to have settled between seventy and eighty percent, suggesting that there may be some optimal relationship between acreage owned and used. This may change with the removal of land witholding incentives after the 1972 crop year. (See Table 2)

Laborers, including unpaid family workers, increased from 1880 to 1940, then decreased rather rapidly. The expansion of the farm work force was most rapid in the 1890's and the 1930's. In the 1890's, the physical expansion of Minnesota agriculture was greatest; and in the 1930's, during the national economic depression, rural-urban migration slowed, and many urban dwellers returned to the farms.

Capital, the other major factor of production in agriculture, is best represented by the power available to farmers, from either animals or machines (tractors). Converting the numbers of tractors into horsepower equivalents (table 3), a consistent series can be constructed following Hayami and Ruttan's method. Capital available per worker increased from two horsepower in 1880 to fifty-eight in 1970. It should be noted that data on tractors on farms before 1920 is not readily available. Consequently, the total series understates capital before 1920, and may also understate capital available after 1950 (when horses and mules were no longer reported). In addition, the series may over-state the capital available between 1920 and 1950, since some of the horses and mules counted may not have been used as power sources.

TABLE 3: LABOR AND CAPITAL INPUTS IN MINNESOTA AGRICULTURE, 1880-1970

YEAR	LABOR (000)	CAPITAL: ANIMALS (000)	MACHINES[a] (000)	TOTAL[b] (000)
1880	131	266	---	266
1890	160.1	412.8	---	412.8
1900	252.6	514.2	---	514.2
1910	273.6	770.6	---	770.6
1920	288.1	939.2	398.7	1337.9
1930	301.6	815.6	1187.6	2003.2
1940	359	653	2816	3469
1950	277	268	5533.8	5801.8
1960	235	---	9201.3	9201.3
1970	187	---	10929.8	10929.8

SOURCES: Labor from U. S. Bureau of the Census, _Census of Agriculture_, 1880-1970; Animals from _Ibid._; Machines, translated to horsepower equivalents, from Ibid., adjusted by horsepower data from U.S.D.A., E.R.S., _Farm Cost Situation_, 1964, U.S.D.A., E.R.S., _Changes in Farm Production and Efficiency_, _Statistical Bulletin_ 233, revised, July, 1965, and revised, 1972.

[a]Numbers of tractors in Minnesota time average horsepower per tractor for U.S. for same year.

[b]Total of animal and machine horsepower, following Hayami and Ruttan, _Agricultural Development_, pp. 334-336.

Over the entire 1880-1970 period, only the value of output and capital inputs have grown. Land and labor have both declined. This suggests that the over-all trend in output per worker should be positive, and output per acre should also increase. Acres per worker would increase if land inputs declined more slowly than labor inputs. As table 4 indicates, output per worker and its two components all increased between 1880 and 1970.

PRODUCTIVITY CHANGE

The primary measure of productivity is output per worker. This measure has two components in agriculture: acres per worker; and, output per acre. Using improved acreage rather than total acreage produces a more accurate measure of land productivity. From these measures, certain information about the magnitude and direction of technical change can be drawn.

Changes in Productivity:

Labor productivity is measured in 1950 constant dollar value of production per worker terms. The 1890's and the 1930's are the only decades in which labor productivity declined. In all other decades, productivity rose. Land expansion accounts for much of the increase in the 1880's, and offsets the declining output per acre in the 1880's, and the 1890's. While more land per worker was being cultivated, the land was declining in quality, either from fertility declines or from decreased disease resistance by crops.

From 1900 to 1920, the amount of land per worker increased, and the productivity of the land also rose. This increase in land productivity may

TABLE 4: MEASURES OF LABOR AND LAND PRODUCTIVITY, MINNESOTA AGRICULTURE, 1880-1970

YEAR	OUTPUT PER WORKER	ACRES PER WORKER	OUTPUT PER ACRE
1880	1,936.2	55.3	35.0
1890	2,376.7	69.5	34.2
1900	2,266.6	73	31
1910	3,139.8	71.8	43.7
1920	3,788.3	74.6	50.8
1930	4,039.7	92	43.9
1940	3,845.4	61	63.2
1950	5,985.8	108.3	47
1960	7,047.3	94	75
1970	10,268.3	121.1	85

SOURCE: Output per worker calculated from tables 1 and 3; acres per worker from tables 2 and 3; output per acre from tables 1 and 2. See text for formulae.

be due to increased fertilizer usage, but the consumption of fertilizer by Minnesota farmers in the years before 1920 is not documented. The development of winter-hardy crops with shorter growing seasons by the Minnesota Agricultural Experiment Station should have begun to bear fruit in this period, and may account for part of the increase in land productivity. Better land management techniques may also play a part; along with the commercial planting of new, disease resistant strains of wheats and other cereal crops. It is quite likely that the Minnesota Agricultural Experiment Station contributed to these increases. Both land per worker and land productivity increased, causing substantial increases in output per worker.[5]

After 1920, the trends in labor productivity and its components become more diverse. Land productivity increased in the 1930's, and the 1950's and 1960's. Land per worker increased in the 1920's, 1940's, and the 1960's. Labor productivity increased in the 1920's, and after 1940. In the 1930's, more people returned to the land, and the numbers of farms increased, contributing to the fall in labor productivity. During this decade, land productivity increased, indicating that some biological innovations had been adopted by Minnesota farmers. Mechanical innovation was discouraged during this decade because of the decline in the price of labor relative to the price of capital.

---

5 See Andrew Boss, Minnesota Agricultural Experiment Station, 1885-1935, Minnesota Agricultural Experiment Station Bulletin 319 (St. Paul, 1935), passim; Andrew Boss, "Achievements of the Minnesota Experiment Station," in Agricultural Research T ough Fifty Years, 1885-1935 Minnesota Agricultural Experiment Station (St. Paul, 1936), passim.

In the 1920's and the 1940's, land productivity declined, but land per worker and labor productivity expanded. This suggests that the relative price of labor rose, while that of machinery fell, encouraging the substitution of tractors and other machines for human power. Since horses and mules increased in numbers during the 1920's, the cost of animal power also fell relative to the price of labor, and animal power was again substituted for human power. In the 1940's, horses and mules on farms declined, suggesting that the price of animal power had risen relative to machinery prices, and that the productivity of animals had decreased relative to machinery productivity.

In the 1950's, the use of fertilizers and other biological innovations increased rapidly. Land productivity rose, stimulating a rise in labor productivity. Land per worker declined, indicating that biological innovation was relatively less expensive than machinery, and suggesting that the price of land had risen relative to the price of labor.

The decade of the 1960's presents a different story, similar to that of the 1910's. The price of labor relative to the price of land rose, encouraging the use of land, necessitating more mechanical power. At the same time, the price of machinery rose relative to the price of land, necessitating land-saving biological techniques. All input prices shifted, encouraging the optimization of resource use along new paths. The result was to encourage land and labor intensive agriculture for the first time in the history of Minnesota agriculture.

Magnitude of Change:

Output per worker ratios can be used to measure the magnitude of technical change in agriculture. If no technical change has occurred between two years, the output per worker ratios will be similar $[(Y/L)_1 = (Y/L)_2]$. If technical change has occurred, the labor needed to produce the output of year 2 (Y_2) with the technology of year 1 (L'_2)

$$L'_2 = (Y/L)_1 Y_2$$

will be greater than the actual labor force in year 2 (L_2). Assuming no technical change had occurred, L' measures the labor force that would be required. Since L' will differ from L, the difference indicates (a) the direction of technical change towards increasing or decreasing labor efficiency, and (b) the magnitude of that change.

In 1970, 187,000 farm workers produced crops and livestock valued at 1.92 billion dollars (in constant 1950 dollars). Technical change had occurred since 1880. If such change had not occurred, 991,700 workers would have been needed in 1970, instead of 187,000 that were employed. Similarly, since 1920, technical change had saved, by 1970, 319,000 labor years (506,900 workers [L'] - 187,000 [L]). The largest decadal shift in technology occurred in the 1960's, when 85,500 labor years (272.5 [L'] - 187 [L]) were saved. Technical change was labor-saving, relative to land and capital inputs. This suggests that the price of labor had risen consistently over the period relative to the prices of land and capital.

Direction of Change:

Output per worker ratios can also be used to measure the direction of technical change and innovation in agriculture. The components of labor productivity here become crucial. From the relationship:

$$\frac{Y}{L} = \frac{A}{L} \cdot \frac{Y}{A},$$

labor-saving and land-saving innovations can be determined. Labor-saving technical change is mechanical; land-saving changes are biological. The direction of change can be determined by the relationship between the land per worker and the output per acre ratios. If land per worker increases, ceteris paribus, mechanical, labor-saving innovation has occurred. Similarly, if output per acre increases, land-saving, biological innovation has occurred.

Three possible combinations of innovation can, and did, occur. Only labor-saving, only land-saving, and both labor and land-saving change exhaust the possibilities for positive change. At no time in Minnesota's history has there been a decade when neither land nor labor were saved. The 1880's and 1890's, the 1920's, and the 1940's all were decades of labor-saving, land extensive innovation or change. In the 1880's and 1890's, there is a distinct probability that little if any mechanical innovation occurred, and the land-extensive nature of Minnesota agriculture resulted solely from the physical expansion of agriculture. The 1920's and 1940's are more likely decades of mechanical change.

Land-saving, biological change occurred in the 1900-1910, 1930-1940, and 1950-1960 decades. In 1900-1910, the most likely explanation is that the development of plants with shorter growing seasons and higher yields, better adapted to the climate and soil conditions of Minnesota account for the land-saving bias. In the 1930's, new, disease-resistant plants were available, but the other major biological changes -- fertilizers and pesticides -- were not widely used and unknown, respectively. The 1950's case is clear, both fertilizers, pesticides, and disease-resistant strains were widely used. The combination, similar to that employed in the "Green Revolution" of the 1960's and 1970's in Asia and Africa, brought higher yields. In 1940, the corn yields hovered around forty bushe s per acre; by 1950, they had risen to the mid-fifties per acre.

The 1910-1920 and 1960-70 decades were periods of land- and labor-saving change. Corn yields rose from about thirty bushels per acre in 1910 to forty bushels in 1920; and from fifty-five to eighty or ninety bushels per acre in 1960-1970. Almost every crop experienced increased yields during these two decades. The Minnesota experience in these two decades was similar to the post-World War II experiences of Germany (Federal Republic) and Japan.[6]

---

[6] For the German experience, see Adolf Weber, Productivity Growth in German Agriculture, 1850 to 1970, University of Minnesota Department of Agricultural and Applied Economics Staff Paper P73-1, revised August, 1973 (mimeo, St. Paul, 1973). For the Japanese case, see Yujiro Hayami and Vernon W. Ruttan, Agricultural Development: An International Perspective (Baltimore: The Johns Hopkins Press, 1971); and Yujiro Hayami and Saburo Yamada, "Technological Progress in Agriculture," Economic Growth: The Japanese Experience Since the Meiji Era, ed., Lawrence Klein and Kazushi Ohkawa (Homewood, Illinois: Richard D. Irwin, Inc., 1968).

SUMMARY AND CONCLUSIONS

The record of Minnesota's agricultural development is impressive. Development was rapid from 1880 to 1940. From 1940 to 1970, the rate of growth slowed, but the absolute changes were larger. To 1930, growth resulted primarily from the expansion of land in farms and farm workers. The decade of the 1930's, a period of depression, drought, and dispair, experienced increased agricultural production while labor productivity dropped. The post-1940 period of growing output was also a period of shrinking labor force, declining farms, and larger capital inputs. During this period, the efficiency of the labor force was increased by mechanical and biological innovation, as well as by the expansion of land and capital.

Summary:

Labor productivity increased in eight of the nine decades studied, declining only in the 1930's. Dividing labor productivity into its component parts: land area per worker; and land productivity, the direction and the magnitude of technical change in agriculture can be inferred. On balance, mechanical innovation has been more important in the long-run of Minnesota's agricultural growth. Biological innovation is increasing in importance, and the two forces appear to be supporting each other in the 1960's and beyond.

To 1950, Minnesota agriculture was land extensive, and labor intensive. Machine power replaced animal power which had earlier replaced human power on Minnesota farms. Biological innovations supplemented this process by providing fertilizers, pesticides, and crops adapted to the soil and climate. The combination of machinery and biological innovations together increased land productivity. Machine power made possible larger land per worker ratios. Together, these factors account for much of the increased labor productivity in Minnesota agriculture.

Technological change in Minnesota agriculture was labor-saving. In some decades, land-saving change occurred. After 1960, both land and labor were saved by technological changes. From these movements, the relationships between the prices of labor, land, and capital (machinery horsepower) were inferred. In most years, the price of labor rose relative to the price of land. In some years, the price of capital rose in comparison with the price of land, necessitating land-saving measures. After 1960, relative prices have shifted to favor both the saving of land and the saving of labor.

Implications

Agricultural histories of Minnesota (and of other states as well) can be refined by the use of appropriate tools. In this study, labor productivity and its components were analyzed to determine: 1) the direction; and 2) the magnitude of technical change; and 3) to determine the relationships between the prices of land, labor, and capital. Labor productivity increases help to explain the development of Minnesota agriculture between 1880 and 1970. In addition, use of the appropriate tools allows the historian to substitute for missing or unavailable data theoretical constructions which are of considerable use.

APPENDIX

CONSTRUCTION OF THE VALUE OF PRODUCTION SERIES FOR 1880-1970

Data:

For each crop, vegetable, and fruit listed (below), the acreage harvested (where appropriate), production, and value were totalled for five year periods surrounding the census years (e.g. 1878-1882 for 1880) and the averages determined. Average yields and average prices were also obtained. For livestock, numbers of animals on farms 1 January of each year were substituted for acres and production. Because of difficulties in aggregating slaughters, sales, and stock on farms, only stock figures are utilized.

Dairy products and eggs, wool, and other minor products were excluded. Frequently, data was missing from published sources (see below), or was not convertible to a common series.

Coverage:

Vegetables and fruits: sugar beets; sweet corn; green peas; onions; cabbage; and commercial apples.

Crops: potatoes; buckwheat; corn; oats, barley; winter wheat; durum wheat; spring wheat; rye; flax; and soybeans.

Livestock: all cattle; sheep; swine; horses and mules; poultry; and turkeys.

Methods:

1) Value aggregation:

For all crops and livestock for each year, the values $(p_i q_i)$ were totalled. This gives a current dollar series denoted $p_i q_i$.

2) The value index:

The base year (1950) total value ($p_o q_o$) was used:

$$\frac{p_i q_i}{p_o q_o} = \text{value index}$$

3) Aggregate price index:

The base year (1950) prices (p_o) of each crop and livestock entry were multiplied by the quantities produced for each year (q_i):

$p_o q_i$;

and entered in the equation:

$$\frac{p_i q_i}{p_o q_i} = (100) = \text{price index.}$$

4) Constant 1950 values:

The aggregate value series ($p_i q_i$) were adjusted using the price index (3, above):

$$\frac{p_i q_i}{X} = \frac{\text{price index}}{100}\text{, multiplying through gives:}$$

$$X = \frac{100\ (p_i q_i)}{\text{price index value for year } i}$$

5) Sources of Data:

Minnesota Agricultural Statistics, 1964, 1973; Minnesota Annual Crop and Livestock Statistics, 1926-1927; Richard J. Schrimper, Minnesota Agriculture -- Crops, 1858-1958; David O. Mesick, Minnesota Agriculture -- Livestock, 1858-1959; Robert E. Marquardt, Minnesota Agriculture -- Prices, 1867-1959; S. Hundley, Minnesota Agriculture: Prices, 1958-1970.

TABLE 5: $p_i q_i$ and $p_o q_i$ SERIES FOR MINNESOTA AGRICULTURE, 1880-1970

YEAR	$p_i q_i$	$p_o q_i$
1880	84176.5	251829.7
1890	131276.2	380021.1
1900	163177.8	573094.7
1910	291215.8	859101.0
1920	558807.2	1091738.7
1930	453229.7	1219280.4
1940	739103.4	1383956.7
1950	1449198.5	1449198.5
1960	1240438.6	1657299.3
1970	1956661.3	1920450.9

SOURCE: See appendix for calculations.

TABLE 6: PRICE INDEX FOR MINNESOTA AGRICULTURE, 1880-1970, EVERY FIVE YEARS, USING FIVE YEAR AVERAGES
(1950 = 100)

YEAR	PRICE INDEX	YEAR	PRICE INDEX
1880	33.4	1885	22.2
1890	34.5	1895	23.5
1900	28.5	1905	30.0
1910	33.9	1915	50.1
1920	51.2	1925	41.7
1930	37.2	1935	37.1
1940	53.4	1945	88.8
1950	100.0	1955	80.2
1960	74.9	1965	76.2
1970	101.9		

SOURCE: Calculated from data in table 5 and the $p_o q_i$ series (available from the author upon request) using the formula listed in the appendix, p. 23.