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THE ROLE OF IMPORTS IN THE CHANGING NATURE OF THE U.S. FARM MACHINERY INDUSTRY

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Imports of tractors and other farm machinery have become increasingly important to the U.S. farm machinery industry. Aggregate imports increased from approximately $100 million* in 1970 to $950 million in 1980, with tractors and harvesting machinery accounting for the largest share of this total.[1/] From 1982 to 1983, the U.S. machinery trade balance for tractors and harvesters shifted from a positive $278 million to a deficit of $93 million. Imports of tractors and harvesting machinery totalling $150 million from Japan and $185 million from the Federal Republic of Germany significantly contributed to the trade deficit in 1983.[2/]

The growth in foreign penetration into the U.S. machinery market has been achieved with little resistance from U.S. manufacturers.[3/] Increasing farm sizes during the past two decades have prompted U.S. manufacturers to target their efforts toward large machinery production.[4/] As the demand for small tractors expanded during the 1970's, Japan willing entered the U.S. market to fill the void. These imports are sold both under the labels of foreign manufacturers, and under the labels of U.S. firms through joint-venture agreements. In 1983, all tractors less than 40 h.p. on the U.S market were produced abroad.

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* Data for 1970 imports of harvesting machinery is not available, so this figure is estimated by assuming these imports constitute roughly 25% of the annual total imports.

1/ U.S. Bureau of Census, Dept. of Commerce, Current Industrial Reports; 1970-1980.

2/ U.S. Dept. of Agriculture, Economic Research Service, Outlook and Situation Inputs: 1984, p. 1.

3/ Interview with Darrell Payne, Division Sales Manager, John Deere Company, Minneapolis, April 1984.

4/ "Keeping Pace with Changing Farm Size," Implement and Tractor, January 1984, pp. 18-20.

In addition to small Japanese tractor imports, a large number of mid-sized European tractors are imported annually. These products not only supplement the lines of some U.S. firms (similar to Japanese imports), but in some instances compete directly with U.S. lines. Presently, each of the six largest manufacturers has some of its farm equipment built by foreign-owned firms.

Despite the presence of foreign firms in the U.S. market, the market structure of the large farm machinery industry remains highly concentrated with declining purchases of farm machinery. Manufacturers have attempted to cut costs by reducing inventories, trimming unprofitable product lines, and are engaging in more joint-venture agreements with foreign and U.S. firms.

The distribution network of the farm machinery industry has also undergone significant changes. In the 1940's, there were 35,000 farm equipment dealerships in the U.S. By the early 1980's, this number had dropped to approximately 10,000. Factors such as declining numbers of farmers, a trend toward larger-volume dealerships able to benefit from large-scale selling, the currently depressed market for farm machinery, and changing manufacturer-dealership relationships have contributed to the change in dealership numbers.

The purpose of this study was to examine changes in the demand for, and the supply of farm machinery, and the role of imports in regard to these changes. A study of this nature is relevant and useful in helping dealerships, farmers and the overall farm machinery industry better understand the forces behind some of the changes occurring in the industry.

The specific objectives of the study were: (1) to discuss demand determinants, elasticities, and trends in usage for the U.S. and Minnesota; and to examine tractor demand by farm size in Minnesota (2) to document the magnitude of imports, and import purchases in the U.S. (3) to examine the characteristics of the U.S. farm machinery industry that have fostered the development of

imported machinery into the U.S. market, and (4) to examine some perceived changes in Minnesota dealerships in terms of product lines carried, customers served, geographic area served and inventory investment, and to examine the possible impact that imports may have had on these changes.

During the course of this study, several limitations were encountered. Among these are: the assumptions about small tractor demand are limited because they are based on data from selected farms in one Minnesota county; the magnitude of import sales by foreign firms are difficult to interpret because market share data is not available, and import data does not distinguish between imported machines manufactured by U.S. firms overseas or by foreign firms overseas; and, dealership changes and increased imports occurred simultaneously making it difficult to separate the effects of imports on these changes.

FARM MACHINERY DEMAND

Although this study is mainly concerned with new machinery demand, it is important to note that alternative markets exist. Users can gain machine services through the used, leasing, and rental markets.

The year to year fluctuation in machinery purchases largely result from the fact that new machinery purchases (like all durable inputs) can easily be postponed if income falls, and if existing stocks can still perform the needed services.5/

Cromarty analyzed the demand for farm machinery from 1926-1955 as a function of: all prices paid by farmers, equity position of farmers, labor costs, machinery prices, prices received by farmers, stocks of machines on farms, net farm income, and farm size. Only the first three variables were considered

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5/ Liebenluft, Robert F., "Competition in Farm Inputs: An Examination of Four Industries," Policy Planning Issues Paper, Federal Trade Commission, (Feb. 1981)

significant determinants of demand for farm machinery. Cromarty estimated demand elasticities with respect to farm income, farm prices, and farm assets to be inelastic, and unitary with respect to machinery prices. Farm size was found to be positively related to purchases.6/

Heady and Tweeten analyzed the demand for farm machinery from 1926-1959, and found machinery prices and farm income (reflected in farmers' equity) explained the major portion of variation in machinery purchases during this period. Demand elasticities with respect to machinery prices and farm prices were determined to be unitary.7/

More recent work by Gungal and Heady analyzed the demand for tractors, harvesting machinery, and other equipment individually. All price elasticities were found to be inelastic, with tractors more inelastic than harvesters; other machinery was found to be more elastic than tractors and harvesting equipment, probably because the latter two have a higher replacement priority.8/

In addition to these determinants, service characteristics are a unique component of the demand for farm machinery. Due to the high cost of machinery, and the importance of timeliness in certain farm operations, when farmers buy machinery, they buy not only machines, but assurance of future reliability and service from the dealership.9/ Several studies have concluded that factors

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6/ Cromarty, William A., "The Farm Demand for Tractors, Machinery and Trucks," Journal of Farm Economics, (May 1959), pp. 323-331.

7/ Heady, Earl O. and Tweeten, Luther G., Resource Demand and Structure of the Agricultural Industry, (Ames, Iowa: Iowa State University Press, 1963), pp. 289-301.

8/ Gungal, Kisan R. and Heady, Earl O., "Economic Analysis of U.S. Farm Mechanization," Card Report 119, Center for Agricultural Development, Iowa State University (1983), pp. 29-67.

9/ Liebenluft, Robert F., "Competition in Farm Inputs: An Examination of Four Industries," Policy Planning Issues Paper, Federal Trade Commission, (February 1981), pp. 123-124.

such as dealer proximity and reputation, product and dealer reliability, trade-in policy, parts availability, and service capabilities were important considerations for farmers when selecting a dealership.[10/]

U.S. Demand

Annual investment trends in tractors and all farm machinery is illustrated in Figure 1. Despite year to year fluctuations, aggregate investment has trended upward in current and constant value terms during this period. Tractor investment shows an upward trend in current terms, but in real terms has remained relatively constant.

Detailed data on retail sales of selected types of farm machinery from 1970-1983 are provided in Table 1. It is significant to note that tractors less than 40 h.p., were the only category of equipment demonstrating an overall increase during this period.

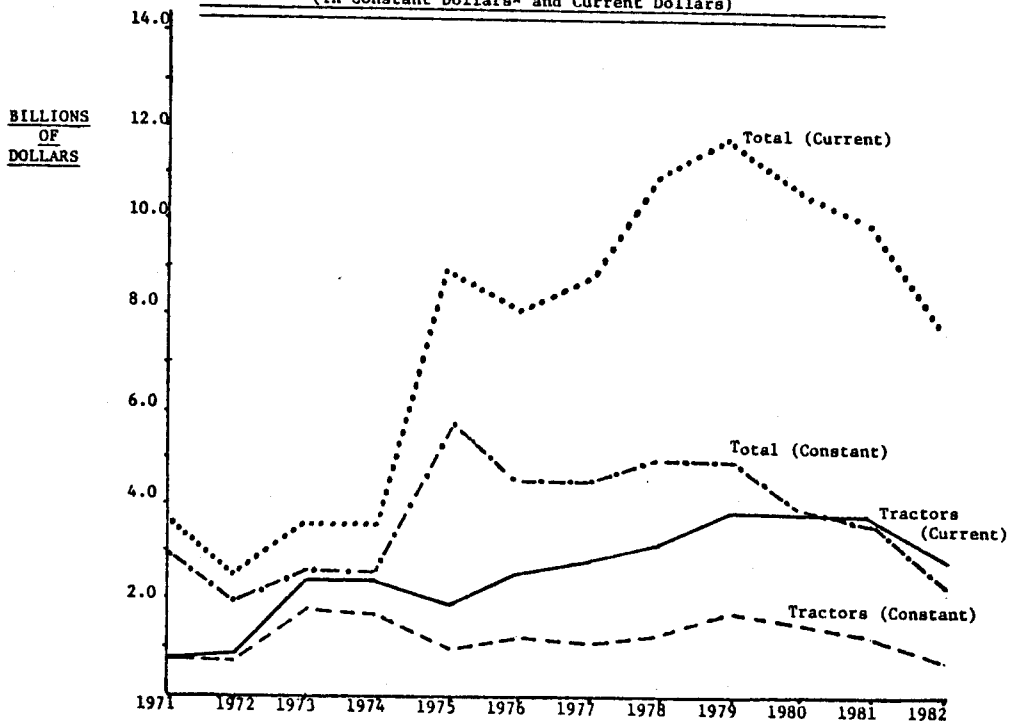
Despite wide yearly fluctuations in machinery purchases, machinery stocks on farms grew dramatically from 1940-1979. Table 2 shows a rapid growth in the number of several types of farm machines until the mid 1960's, at which point the numbers begin to decline. This may be attributed to qualitative changes in machines, their increased capacity, and a decrease in number and increase in the size of farms.[11/] Machinery stocks in current and constant value terms have also exhibited an upward trend during this period.

10/ This statement is a composite of several studies:
Lievenluft, op cit, p. 124.
"What Makes Farmers Buy?", Implement and Tractor, May 1983, p. 221.
"Future Planning Analysis - External Evaluation," The National Farm Power and Equipment Dealers Association, August 1979, p. 17.

11/ Gunjal and Heady, Op cit, pp. 3-4.

FIGURE 1

U.S. MACHINERY INVESTMENT, 1971-1982
(In Constant Dollars* and Current Dollars)



(Expenditures for all farm machinery includes: tractors and self-propelled machinery, and other machinery, implements, and livestock equipment; tractor expenditures for new and used.)

*Values are deflated by the producer prices index for farm machinery, using June levels of each year, with 1967 as the base year.

SOURCE: USDA/ERS: "Farm Production Expenditures"; 1971-1982.

TABLE 1

U.S. RETAIL SALES OF SELECTED FARM MACHINERY, 1970-1983
(IN 1000'S UNITS)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Two-Wheel Drive Tractors, <40hp:	31.8	28.2	33.2	40.3	32.0	22.4	15.9	24.0	36.2	49.3	46.7	48.1	50.0	45.6
Two-Wheel Drive Tractors,>40 hp:	103.7	103.3	123.6	150.3	133.5	128.2	126.8	123.2	130.9	127.5	108.4	94.2	70.4	66.2
Four- Wheel Drive Tractors:	N/A	12.6	3.9	6.5	8.3	10.6	10.5	7.7	8.7	11.5	10.9	9.7	6.8	5.1
Combines:	26.7	27.2	27.9	35.1	31.6	33.1	32.5	28.8	31.5	32.2	25.7	26.8	16.2	12.8
Forage Harvesters:	15.0	14.8	15.2	17.7	16.1	13.1	13.3	13.1	11.5	12.5	9.5	7.6	5.1	4.1
Balers:	29.3	28.3	31.6	36.9	29.3	26.1	22.3	21.4	21.1	18.8	14.0	13.6	8.9	9.0
Mowers-Cond.:	N/A	20.0	21.6	27.4	26.4	24.8	22.8	22.1	25.0	25.6	19.5	18.5	14.0	14.3
Windrowers:	N/A	10.7	10.9	12.9	11.3	10.1	10.2	9.3	8.7	8.6	7.1	6.6	4.12	2.6

SOURCE: Unpublished data from the Farm and Industrial Equipment Institute, Annual Retail Sales Data.

TABLE 2

NUMBER OF MACHINES ON U.S. FARMS
(THOUSANDS OF UNITS)

Year	Tractors	Grain Combines	Corn Pickers	Balers	Forage Harvesters
1940	1567	190	110	N/A	N/A
1945	2354	375	168	42	20
1950	3394	714	456	196	81
1955	4345	980	688	448	202
1960	4688	1042	792	680	291
1965	4787	910	690	751	316
1970	4619	790	635	708	304
1975	4469	524	615	667	255
1976	4434	527	610	641	263
1977	4402	535	605	615	270
1978	4370	538	602	610	272
1979	4350	540	600	605	272

SOURCE: Gunjal, Kisan and Heady, Earl, "Economic Analysis of U.S. Farm Mechanization," Card Report 119, Center for Agricultural Development, Iowa State University (1983) p. 4.

Minnesota Demand

The growth in Minnesota machinery stocks during the past four decades is very similar to the trend in U.S. stocks, especially for tractors. Retail sales of farm tractors in Minnesota from 1975-1983 are provided in Table 3. It is important to note that purchases of tractors less than 40 h.p. in size increased 250% during this period, and increased from 1.8% in 1975 to 12.9% in 1983 as the share of total Minnesota tractor purchases. This category is important to this analysis because all of these machines are foreign sourced.

With retail sales of small tractors showing an increase in Minnesota, and at the national level, it is useful to examine purchases according to farm size as a means of partially explaining this trend.

First, the distribution of farms by size (acres) has undergone change. From 1974-1982, average farm size has remained relatively constant, but small farms (1-49 acres) and large farms (larger than 500 acres) have increased in numbers, while average farms (50-499 acres) have declined.[12/]

The distribution of farms according to farm income shows further change. Small farms (less than $40,000 annual farm income) declined, while larger farms (more than $40,000 annual farm income) increased during this period.[13/]

To better understand the nature of tractor purchases in Minnesota, data from a 1984 survey of 163 Dodge County farms was analyzed.[14/] By examining farm size (acres), farm size (income), and days worked off-farm by primary operator, with respect to tractors on farms, certain inferences can be drawn regarding tractor usage on Minnesota farms.

12/ Minnesota State Planning Agency, State Demographers Office, Population Notes, August, 1984.

13/ U.S. Bureau of Census, 1974-1982 Census of Agriculture-Minnesota.

14/ This data was provided by Jean Sussman from a survey she conducted in 1984.

TABLE 3

MINNESOTA RETAIL SALES OF FARM TRACTORS, 1975-1983
(IN UNITS)

	1975	1976	1977	1978	1979	1980	1981	1982	1983
<40 hp	125	103	N/A	N/A	N/A	N/A	N/A	N/A	441
40-59	453	467	422	435	371	338	263	184	143
60-79	1060	860	815	865	1063	710	576	369	328
80-99	858	514	606	832	761	634	688	517	368
100-119	1024	882	1040	1307	1150	784	616	444	350
120-139	1567	1343	1669	2028	1758	1305	1294	830	632
>140	977	695	876	1093	1004	760	693	449	767
Large 4-W.D.	725	626	421	579	989	767	645	479	386
	6789	5490	5849	7139	7096	5300	4775	3272	3415
% of U.S. Total	4.5	3.2	4.0	4.3	4.0	3.4	3.4	2.9	2.9

SOURCE: Farm and Industrial Equipment Institute Retail Sales Data, 1975-1983.

Cross tabulations were run between farm size (acres), farm size (income), and days worked off-farm, respectively, and tractors on farms, classified according to h.p. size. In addition, cross tabulations were run between the first three variables to check for serial correlation.

The cross tabulations given in Table 4 show that 41% of the less than 40 h.p. tractors were on small farms (1-49 acres). Eighty-two percent of the medium-size (41-100 h.p.) tractors were on farms with 50-499 acres, and 100 h.p. plus tractors were found predominantly on farms larger than 180 acres.

In terms of tractors on farms categorized by farm income, Table 5 shows that 38% of the less than 40 h.p. units were on farms with less than $20,000 annual income, and 59% on farms with income less than $40,000, with 32% on farms with income of $40,000-$100,000.

Chi-square analysis was used to determine the statistical relationship between size of tractors on farms, and farm size (acres), farm size (income), and days worked off-farm respectively. The results are summarized in Table 6. Farm size (acres) and farm size (income) were both found to be non-independent (associated) with tractor size on farms. Farm size (acres) and farm size (income) were also found to be non-independent, indicating serial correlation between these variables.

To analyze the strength and direction (i.e., positive or negative) of the relationship between tractor size and farm size, simple regression was used. The results summarized in Table 6 indicate a positive relationship between farm size and tractor size, yet the R^2's do not indicate a strong relationship.

To summarize, the Dodge County data demonstrates a positive relationship between tractor size on farms and farm size (measured in acres and gross income). In Minnesota and the U.S. in general, the growth in small farms accompanied by an increase in the demand for small tractors during the past decade further supports this data.

TABLE 4

TYPES OF TRACTORS ON FARMS ACCORDING TO SIZE OF FARM (FARM SIZE MEASURED BY ACRES)

Farm Size (Acres)	Tractor Size (hp) <40 hp	41-100 hp	101-150 hp	150 hp+	Totals
1-49	15 / 41*	7 / 7	0 / 0	0 / 0	22
50-179	13 / 35	44 / 44	6 / 14	0 / 0	63
180-499	6 / 16	38 / 38	25 / 57	1 / 8	70
500-999	3 / 8	11 / 11	10 / 23	5 / 42	29
100+	0 / 0	0 / 0	3 / 6	6 / 50	9
TOTALS	37	100	44	12	193

*The first value is the observed value, the second value is the % of column total.

TABLE 5

TYPES OF TRACTORS ON FARMS ACCORDING TO SIZE OF FARM (FARM SIZE MEASURED BY FARM INCOME)

Farm Size (Income)	Tractor Size (hp) < 40 hp	41-100 hp	101-150 hp	150 hp+	Totals
<20,000	13 / 38*	18 / 19	5 / 13	0 / 0	36
20,000-39,999	7 / 21	22 / 23	3 / 7	0 / 0	32
30,000-99,999	10 / 29	31 / 32	10 / 25	2 / 20	53
100,000-249,999	4 / 12	23 / 24	16 / 40	4 / 40	47
250,000+	0 / 0	2 / 2	6 / 15	4 / 40	12
TOTALS	34	96	40	10	180

*The first value is the observed value, the second value is the % of column total.

TABLE 6

SUMMARY OF DODGE COUNTY DATA

Relationship Tested	Chi-Square
Farm Size (Acres)/ Tractor Size	S***
Farm Size (Income)/ Tractor Size	S***
Days Worked Off-Farm/ Tractor Size	NS
Farm Size (Acres)/ Farm Size (Income)	S***
Days Worked Off-Farm/ Farm Size (Income)	S***
Farm Size (Acres)/ Days Worked Off-Farm	S***

NOTE: S*** = Significant @ .99
N/S = Not Significant

TABLE 6 (Continued)

SUMMARY OF DODGE COUNTY DATA

Relationship Tested	Regression r^2	Regression B_1
Farm Size (Acres)/ Tractor Size	.40	+.001
Farm Size (Income)/ Tractor Size	.29	+.000002
Days Worked Off-Farm/ Tractor Size	.12	-.002
Farm Size (Acres)/ Farm Size (Income)	.84	+314.5
Days Worked Off-Farm/ Farm Size (Income)	.10	-476.00
Farm Size (Acres)/ Days Worked Off-Farm	.11	-.08

U.S. FARM MACHINERY TRADE

World trade in agricultural machinery in 1978 amounted to about $10 billion (U.S.). Of this total trade, about 55% of the value was accounted for by tractors, 26% by combines, and 19% by all other types of agricultural equipment. Developed countries accounted for 82% of the value of world exports, and 62% of the value of world imports. In world tractor trade, North America accounted for 29% of the exports, and 22% of the imports.[15/]

The major exporting countries in 1979 were: the U.S., Federal Republic of Germany, the U.S.S.R., German Democratic Republic, Canada, France, United Kingdom, Italy, Belgium, Luxembourg, and the Netherlands. The major importing countries in 1979 were: the U.S., the U.S.S.R., Canada, France, F.R.G., United Kingdom, Poland, Hungary, the Netherlands, Australia, and Mexico.[16/]

The production process for tractors and combines is unique in the sense that all firms are heavily reliant on other industries to supply major components, parts, and accessory systems (for tractors, about 50% of total manufacturing costs). Also, economies of scale in tractor and combine manufacturing exist particularly in the developed countries. For these and other reasons, the major manufacturers have sought to rationalize their production processes in order to maintain or improve their product cost competitiveness.[17/] The interdependence between firms in the worldwide production and assembly of farm tractors is shown in Table 7.

15/ "Transnational Corporations in the Agricultural Machinery and Equipment Industry," United Nations Center on Transnational Corporations, (New York: 1983) pp. 52-53.

16/ Ibid, pp. 52-53.

17/ Ibid, p. 46.

TABLE 7

FARM TRACTORS AND WHERE THEY ARE BUILT, JANUARY 1, 1982

BRAND NAME	MODEL	ORIGIN
Allis Chalmers	5020, 5030	Built in Japan by Toyosha Company.
	5040, 5045, 5050	Made in Romania under Fiat License.
	160, 165	Made in France by Renault.
	170, 175	Uses English made Perkins Engine.
Belarus*	ALL MODELS	Built in U.S.S.R. (Russia)
Bolens	152, 154, 172, 174, 192, 194, 242, 244, 292, 294	Built in Japan by Iseki Agricultural Machines Company, uses Mitsubishi and Isuzu Engines
Case/David Brown	885, 990, 995, 1200, 1210, 1212, 1410, 1412	Made in England by David Brown Subsidiary of Tenneco Company
John Deere	650, 750, 850, 950, 1050, 1250	Made in Japan by Yanmar Diesel Engine Ltd.
	820, 2040, 2840, 2940, 1530	Built in West Germany.
Ferrari*	ALL MODELS	Made in Italy
Fiat*	ALL MODELS	Made in Italy
Ford	1000, 1100, 1200, 1300, 1500, 1600, 1700, 1900	All 1000 thru 1900 built in Japan by Shibaura Subsidiary of I.H.I. under contract with Ford
	2000, 2610, 3000, 3610, 4000, 4610, 5000, 5610	Engines & hydraulics made in England; Trans. & Axles made in Belgium.
	7000, 7600, 7610, 7700, 7710, 8000, 8600, 8700, 9000, 9600, 9700, TW10, TW20, TW30	Engine, some hydraulics made in England; transmissions, axles for some made in Belgium and some others in West Germany. Assembled in USA.
	FW20, FW30, FW60	Made by Steiger; axles built in government-owned factories in Hungary.
G.B.T.	Gasoline Models	Engines built in France.
	Diesel Models	Engines built in Japan.
Hefty	Gasoline Models	Engines built in France.
	Diesel Models	Engines built in Japan.
Hesston	ALL MODELS	Made in Italy by Fiat.
Hinomoto	ALL MODELS	Made in Japan by Toyosha Company.

TABLE 7 --Continued

BRAND NAME	MODEL	ORIGIN
International Harvester	234, 244, 254	Made in Japan by Mitsubishi
	274, 284, 284D, 383, 483	Made in Japan by Komatsu Company.
	364	Made in West Germany.
	464, 574, 674	Engine made in West Germany.
	384, 484, 584, 684	Made in Great Britain.
	7388, 7588, 7788	Built by Steiger in Fargo, North Dakota.
Iseki	ALL MODELS	Made in Japan w/Mitsubishi and Isuzu engines; sold by Bolens and White Farm Equipment.
Kubota*	ALL MODELS	Made in Japan.
Leyland	ALL MODELS EXCEPT 154/154D	Made in Great Britain.
	154/154D	Made in Turkey.
Long	260, 310, 350, 360, 445, 460, 510, 560, 610	Built by Universal under license from Fiat in government-owned plant in Romania.
	900, 1100	Made in Poland, engine by Zetor.
	R9500	Made in Italy by Landini under M-F Lic.
	5 N 1 UTILITY	Power train made in England by Leyland.
Massey Ferguson	205, 210, 220	Made in Japan by Toyosha Company.
	135, 235, 164/265, 175/275, 180/285, 230, 245, 255, 265, 275, 285	Perkins Engine made in England; transmission made in France.
	1080/1085	Perkins Engine made in England.
	1105, 1135, 1155, 150-4, 184-4	Perkins Engine made in England.
	2675, 2705, 2745, 2775, 2805, 4800, 4840	Assembled in USA.
Mitsubishi*	ALL MODELS	Made in Japan.
Pasquale	ALL MODELS	Made in Italy.
Satoh	ALL MODELS	Made in Japan.
Same*	ALL MODELS	Made in Italy.
Shibaura	ALL MODELS	Made in Japan; sold by Ford Tractor.
Steiger	ALL MODELS	Made in USA: Axles built in government-owned factories in Hungary.

TABLE 7 --Continued

BRAND NAME	MODEL	ORIGIN
Suzue	ALL MODELS	Made in Japan.
Universal	ALL MODELS	Made in government factory in Romania.
Versatile	ALL MODELS	Made in Manitoba, Canada.
White	2-30, 2-35, 2-45, 2-55, 2-62, 2-67	Made in Japan by Iseki under contractor; uses Mitsubishi and Isuzu engines.
	1265, 1365, 1465, 2-50, 2-60	Made by Fiat in Italy.
Yanmar*	ALL MODELS	Built in Japan by Yanmar Diesel Engine, Ltd. Uses Yanmar engines.
Zetor*	ALL MODELS	Built in government factories in Czechoslovakia.

*Foreign firms marketing tractors under their own lables in North America in 1984.

(Source: Division Sales Department, The John Deere Company)

Another reason for production specialization relates to cost efficiency and the marketing strategy relevant to the domestic landholding structure of the producing country. As a consequence, the major producers of machinery in North America have traditionally directed their production and marketing efforts toward large farmers' needs, the European firms toward medium-sized farm needs, and the Japanese toward the equipment needs of their small producers.[18/]

U.S. Imports of Farm Machinery

The U.S. farm machinery trade position for selected years from 1970-1983 is shown in Figure 2. The figure shows a net exporting position for the U.S. for every year except 1983, when the U.S. experienced a trade deficit of $58 billion. In that year, the trade deficit for tractors and combines reached almost $100 million.

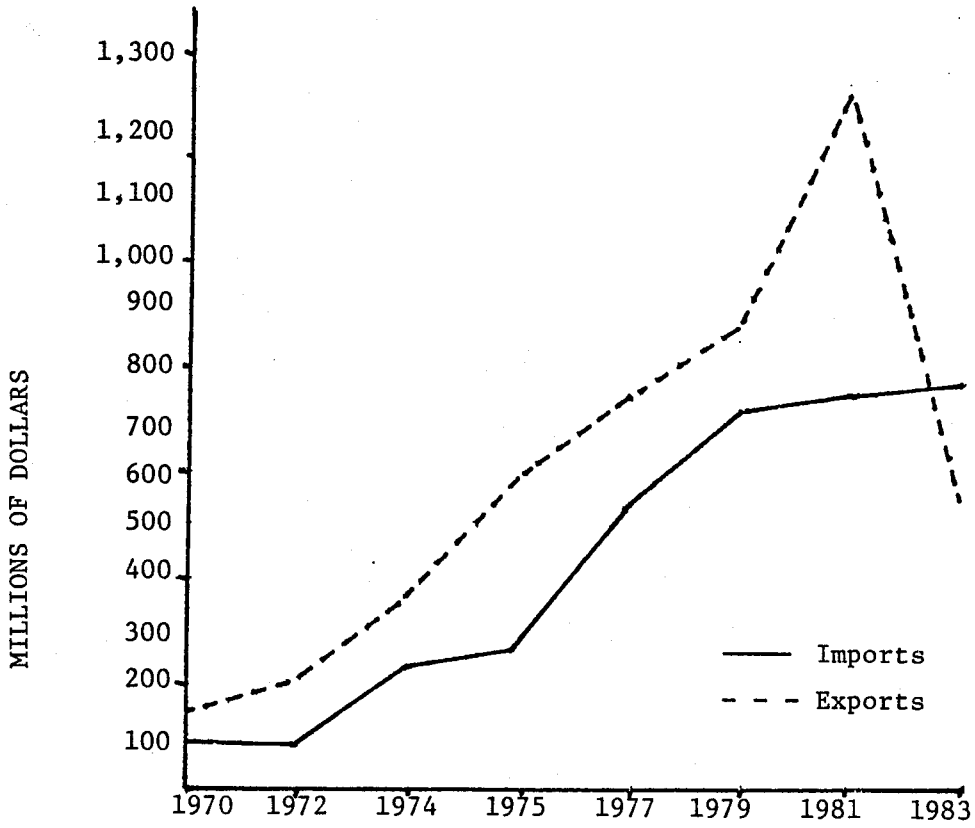
An examination of import trends of farm machinery reveals tractors as the dominant type of import in value terms. Figure 3 illustrates the trend in imports of small tractors (i.e., 40 h.p.) from 1970-1983, and the dominance of the Japanese in this segment of the U.S. market.

Figure 4 illustrates the trend in imports of larger than 40 h.p. units. Several factors must be considered when examining this graph: first, imports of tractors larger than 100 h.p. do not constitute a significant share of this category, most of the tractors are in the 40-100 h.p. range. Second, data is not available to distinguish whether these units were manufactured by U.S.-owned or foreign-owned sources operating overseas. Nonetheless, imports in this category totalled about 42,000 units in 1985. The diagram shows the dominance of the European firms in this segment of the market, with West Germany, and the United Kingdom as the leading exporters into the U.S.

18/ Ibid, p. 47.

FIGURE 2

U.S. IMPORTS/EXPORTS OF FARM MACHINERY - BALANCE OF TRADE
(1970-1983 FOR SELECTED YEARS) IN CURRENT DOLLARS

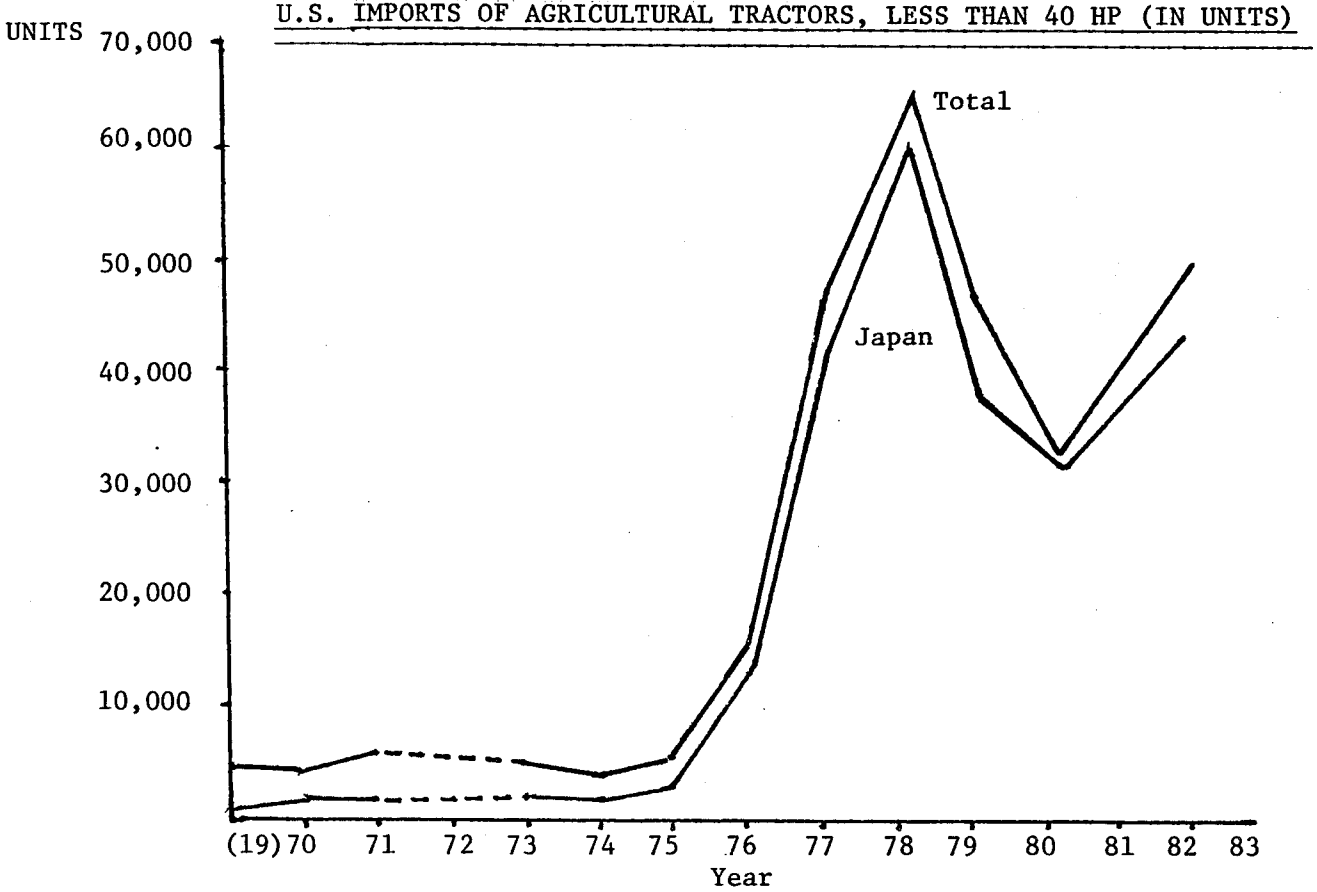


This graph excludes harvesting machinery, because import data is not available for 1970-1975; imports are valued at the first port of entry into the U.S. includes cost, insurance, other costs; exports are valued at point of exportation, includes selling price, inland freight, insurance, other costs.

SOURCE: U.S. Department of Commerce, Bureau of the Census, "Current Industrial Reports - Farm Machinery and Lawn and Garden Equipment, (1970-1983).

FIGURE 3

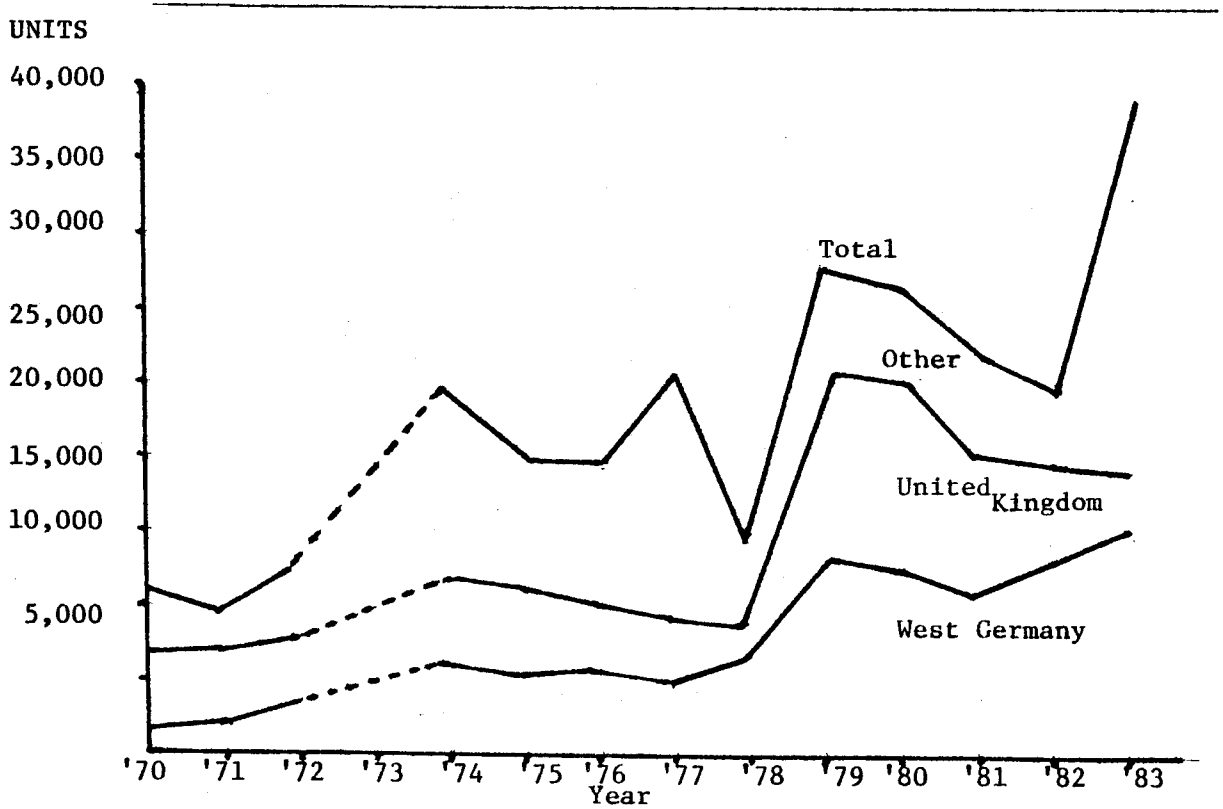
U.S. IMPORTS OF AGRICULTURAL TRACTORS, LESS THAN 40 HP (IN UNITS)



SOURCE: Department of Commerce, Bureau of Census, "TSUSA - Imports for Consumption," Foreign Trade Report 246, (1970-1983).

FIGURE 4

U.S. IMPORTS OF AGRICULTURAL TRACTORS, GREATER THAN 40 HP (IN UNITS)



SOURCE: Department of Commerce, Bureau of Census, "TSUSA Imports for Consumption," Foreign Trade Report 246, (1970-1983).

Import Purchases

The penetration of small and medium-sized tractors into the U.S. market is evident. One method for evaluating the extent of import sales in the U.S. is through market share analysis. For the purposes of this study, imports are defined as any machines crossing U.S. customs that are not manufactured in the U.S. However, as mentioned earlier, data concerning manufacturers of origin of imported machinery is not available, so caution must be used when evaluating the market shares for foreign firms in the U.S. market.

Data on relative market shares of imported equipment are not available at this time. However, market shares can be estimated by comparing the ratio of imports to the apparent consumption of that particular type of machinery. Apparent consumption is calculated as: total U.S. manufactured shipments + imports - exports = apparent consumption.[19/] Market shares are then estimated by taking the ratio of total imports to apparent consumption. Table 8 shows the estimated market shares for selected types of farm equipment from 1970-1983. U.S. market shares for harvesters, cultivators, harrows, plows, and planting machinery declined during this period. Most noticeable is the growth in market share of the less than 80 h.p. category. Despite the large market share, this category obscures the fact that all tractors less than 40 h.p. are imported.

THE U.S. FARM MACHINERY INDUSTRY

The U.S. farm machinery manufacturing industry is composed of three basic types of firms, full-line, long-line, and short-line (dealerships can also be classifited by these terms). Firms are categorized according to the range of products they manufacture (sell) from the following categories:

19/ This method is used by the Commerce Department in their Current Industrial Reports publication.

TABLE 8

IMPORTS OF TRACTORS AND OTHER MACHINERY AS A % OF APPARENT CONSUMPTION, 1970-1983

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Tractors <80 hp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30	49	N/A	54	62	75
Tractors 80-100 hp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	19	36	N/A	25	44	N/A
Tractors >100 hp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	3	N/A	3	4	4
Harvesters[a]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15	14	15	15	9	7	7
Cultivators[b]	16	12	16	14	14	10	15	12	11	13	12	14	12	N/A
Harrows[c]	4	3	4	4	3	2	5	3	2	2	2	3	3	2
Plows[d]	11	11	10	9	N/A	N/A	12	10	6	5	7	5	4	5
Planting/ Seeding[e]	10	9	10	10	10	7	9	10	9	8	10	8	7	9
Hay Mowers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11	14	11	11	14	13

[a] Combines, forage harvesters, and attachments

[b] Cultivators, weeders, and attachments

[c] Harrows, rollers, soil pulverizers, stalk cutters

[d] Plows and listers

[e] Planting, seeding, fertilizing machinery

SOURCE: Department of Commerce, Bureau of Census, "Current Industrial Reports - Farm Machinery and Lawn and Garden Equipment," (1970-1983).

(1) tractors and implements

(2) harvesting machinery

(3) post-harvesting and handling machinery

(4) other machinery for dairy and animal husbandry

By definition, full-line firms manufacture (sell) equipment from at least two of these categories, long-line firms manufacture (sell) from at least one category, and short-line firms manufacture (sell) a limited variety of specialized products from one category.20/

The vertical organization of the U.S. large farm machinery industry is illustrated in Figure 5. The arrows indicate the flow of whole units, and, where specified, machinery components. Firms are categorized as full-line and short-line for simplicity of illustration. Full-line firms distribute machinery produced from their U.S. manufacturing operations, from their overseas operations, from other U.S. suppliers, and from foreign suppliers. Foreign-sourced machinery is basically sold in the U.S. in two ways: (1) through joint-venture with a U.S. firm; or (2) by direct-sell through established U.S. dealerships.

A more detailed description of the distribution of large farm machinery in North America is shown in Figure 6. (This figure represents the left-hand side of Figure 5.) Manufacturers generally use a system of branch houses for admiinstrative sales offices and for warehouse facilities. The sales offices closely supervise and provide assistance to retail dealers.21/

In the U.S., large farm machinery is mainly distributed through a network of independent franchised dealerships. It has been stated that independent

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20/ United Nations, Op. Cit., pp. 56-58.

21/ Liebenluft, Op. Cit., pp. 134-135.

FIGURE 5

INDUSTRIAL ORGANIZATION OF THE U.S. LARGE FARM MACHINERY INDUSTRY

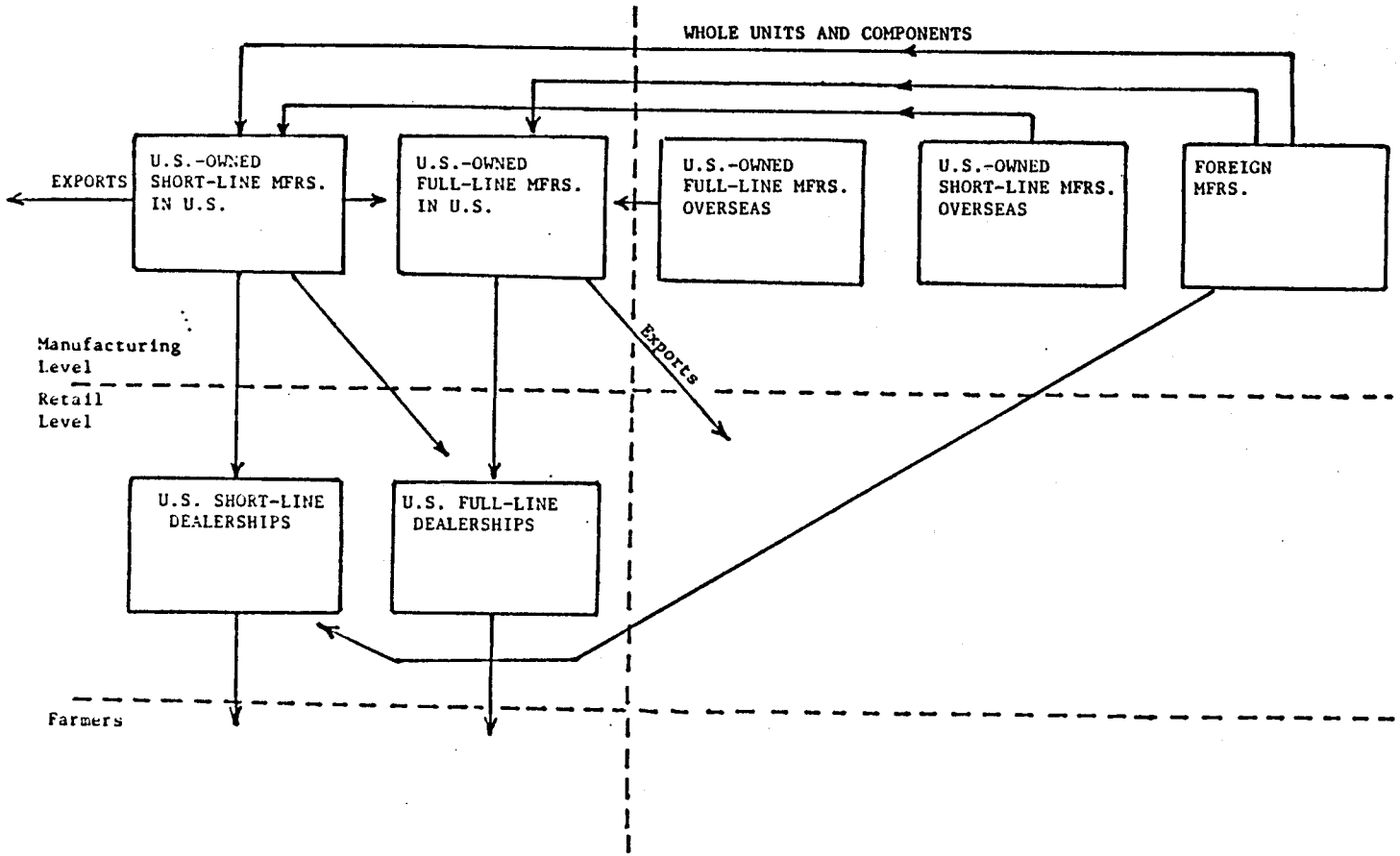
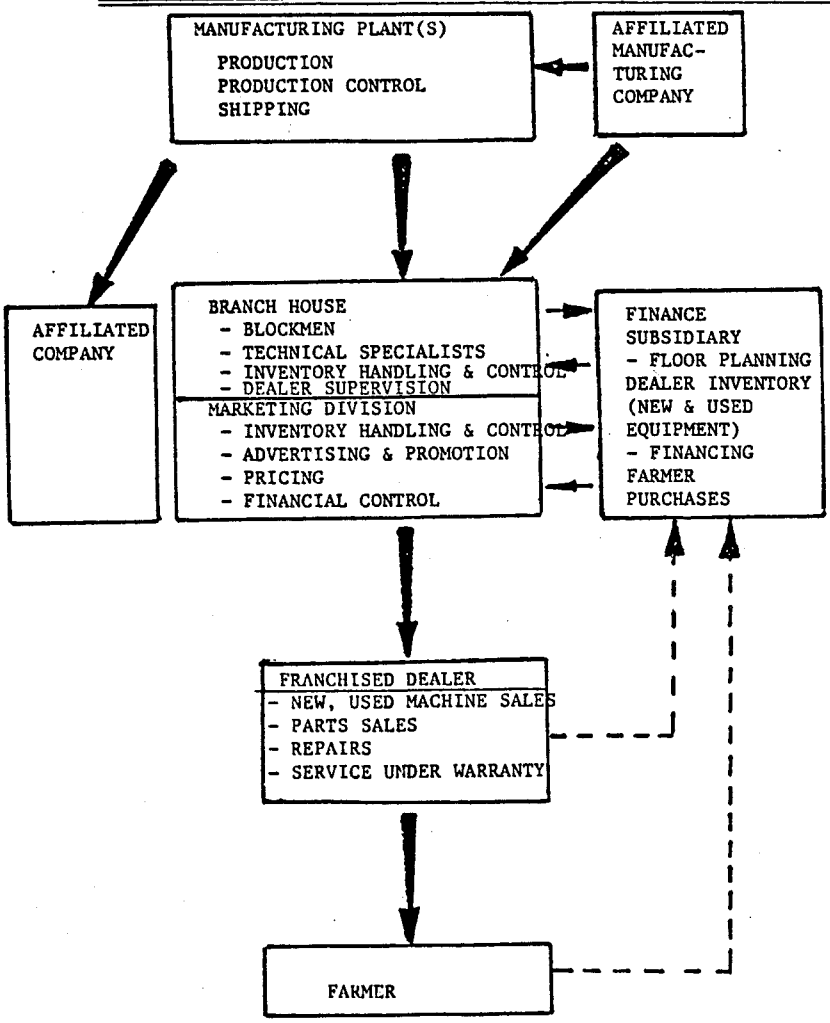


FIGURE 6
DISTRIBUTION SYSTEM FOR LARGE FARM MACHINES IN NORTH AMERICA



——— Flow of Goods

- - - Financial transactions owned and controlled by manufacturer.

SOURCE: Liebenluft, Robert F., "Competition in Farm Inputs: An Examination of Four Industries", Policy Planning Issues Paper, Federal Trade Commission, February 1981, p. 134.

dealerships are more successful than company-controlled dealerships because they are more strongly motivated, they work harder, and tend to be better salesman due to their equity stake in the business.

Also, retail profits are highly dependent on successful trade-ins, and independents have been found to be more skillful at this than company-controlled dealerships.22/

Dealerships receive equipment from manufacturers under an agreement called "floor planning." Under the terms of these agreements, dealers are allowed to hold equipment for certain periods of time before interest charges are incurred. This policy is a device used by manufacturers to keep machines on view near the farmers, and to avoid loss of sales due to temporary shortages.23/ Consequently, manufacturers are largely involved in financing dealership inventories as well as farmer purchases through their credit subsidiaries.

MARKET STRUCTURE OF THE INDUSTRY

The major firms selling farm equipment in the U.S. market are: John Deere, Case-International, Massey-Ferguson, Ford, Allis Chalmers, and the White Motor Corporation. Of the six dominant firms, Deere and Massey are the only firms with agricultural equipment sales constituting the major portion of their sales revenue.

In addition to these firms, numerous long-line and short-line, and foreign firms operate in the U.S. market. Foreign firms selling tractors in the North American market include: Landini, Fiat, Same and Ferrari from Italy, Belarus

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22/ Kudrle, Robert T., Agricultural Tractors: A World Industry Study, (Cambridge, Mass.: J.B. Lippincott Co., 1975), pp. 59-60.

23/ Barber, Clarence L., "The Farm Machinery Industry: Reconciling the Interests of the Farmer, the Industry, and the General Public", American Journal of Agricultural Economics, (December 1973), p. 823.

from the U.S.S.R., Deutz from the Federal Republic of Germany, Steyr from Austria, Zetor from Czechosloviakia, and Kubota, Yanmar, Iseki, Satoh and Toyosha from Japan. Kubota, the largest Japanese firm, supplied over one half of the small tractor inputs into the U.S. in 1980.[24/]

The market shares for the six largest U.S. firms are provided in Table 9. The high industry sales concentration is evident, with John Deere the industry leader followed by Case-International.[25/]

Certain demand and cost (supply) factors have contributed to a higly concentrated indusry. On the demand side, the highly seasonal nature of sales and erratic year-to-year fluctuations have favored the growth and survival of large international firms that can sell in a number of different markets and spread their sales out more effectively.[26/] Consequently, firms must be large enough to have the capability to operate in multiple markets to withstand these demand fluctuations.

On the cost side, two major entry barriers exist: (1) economies of scale in manufacturing, and (2) the high cost of establishing and financing a dealership network.

In terms of the first barrier, research by the Canadian Royal Commission on Farm Machinery in 1968 concluded that substantial savings could result from economies of scale in tractor manufacturing. The Commission found that

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24/ Liebenluft, Op. cit., pp. 131-132.

25/ U.S. Dept. of Agriculture, Economic Research Service, "Outlook and Situation-Inputs 1983," p. 19.

26/ Further data provided by Liebenluft (p. 126-127) shows 80% of all two-wheel drive tractor sales, 68% of all four-wheel drive tractor sales, and 83% of all combine sales were made by the four leading U.S. farm equipment manufacturers in 1979.

TABLE 9

U.S. MARKET SHARES FOR TRACTORS AND COMBINES, 1966 AND 1980
(IN PERCENTS)

	Tractors		Combines	
	1966[a]	1980[b]	1966[a]	1980[b]
John Deere	22	25	35	40
International Harvester[c]	23	15	25	17
Massey-Ferguson	14	10	0	14
Ford	14	17	0	N/A
J.I. Case (Tenneco)[c]	7	7	13	0
Allis-Chalmers	6	6	22	17
White Farm Equipment	8	3	0	4
Other	6	17	5	9

KEY: [a]Estimates based on production numbers.

[b]Estimates based on sales numbers.

[c]Case and I.H. are now one firm.

SOURCE: USDA/ERS: Outlook and Situation: 1983.

manufacturing costs declined about 20% for a given plant as output increased from 20,000 to 90,000 tractors per year.[27/]

The second cost barrier relates to the service factors discussed earlier in the paper. A strong dealership system has been stressed to be a prime requirement for success in the farm machinery industry. In fact, John Deere attributes a large share of their success as indusry leader to their strong dealership network, and reputation for good dealership and customer relationships.[28/] This requirement imposes a significant barrier for firms willing to establish their own distribution network in the U.S. market for several reasons: (1) the costs of establishing a reputable dealership are extremely high, (2) it is difficult for entering firms to overcome the brand loyalty that is believed to exist among farmers.

At the retail level, the important role of service and repair capabilities has increasingly favored the survival of large dealerships. One study of retail dealerships concluded that large dealers can provide better service, and benefit from economies of scale. Average costs per dollar of sales were found to decrease from $1.025 at $500,000 of sales to $0.982 at $3.75 million of sales due to economies in durable investment, and more efficient use of labor.[29/]

Conduct and Performance

In industrial organization analysis, market conduct is defined as patterns of behavior which enterprises follow in adapting to or adjusting to the

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27/ United Nations, Op. cit, pp. 41-43. Although this is 1968 data, the absence of any significant technological changes since then makes the data relevant for the present state of manufacturing.

28/ Payne interview, Op. cit.

29/ Paul, Duane, Cost Economies of Scale in Input Marketing Firms With Special References to California Retail Farm Machinery Dealerships, (unpublished Ph.D. dissertation, University of California, Davis, 1976).

market(s) in which they sell. Performance is the consequence of pursuing whatever line of conduct the firm espouses.30/

The oligopolistically interdependent nature of the farm machinery industry induces firms to engage in "non price" competition. Consequently, firms compete by offering new and improved models in a variety of sizes, models, and options, and by providing better service, improved warranties, and attractive financing options to customers.

In the U.S. farm machinery market, it seems clear that John Deere is the price leader for tractors and several other types of farm machinery. It has been stated that Deere and others have set price levels high enough to earn a high return on their manufacturing assets, which has allowed the smaller firms to survive.31/

The two primary components of performance are efficiency, which is reflected in profits, product prices, and production costs, and secondly, progressivity, which is reflected in the improvement of the industry's final product and the productivity gains achieved by the industry over time.32/

Given the high prices and large profit margins associated with farm machinery, industry profits have been moderate compared to other manufacturing industries. The profitability of the largest farm machinery manufacturers from 1977-1979 is illustrated in Table 10. It should be noted that most of these firms have substantial non-agricultural sales, as well as agricultural machinery sales outside of North America included in these calculations.

30/ Bain, Joe S., Industrial Organization, (New York: John Wiley and Sons, Inc., 1959). pp. 9-12.

31/ Barber, Op. cit., pp. 821-822.

32/ Bain, Op. cit., pp. 340-387.

TABLE 10

PROFITABILITY OF FARM MACHINERY AND OTHER MANUFACTURERS

Company	% Sales in Farm Machinery	% Sales in North America	After Tax Return on Equity			After Tax Return on Sales		
			1977	1978	1979	1977	1978	1979
John Deere	80	80	16.3	15.1	15.7	7.1	6.4	6.3
International Harvester	37	81	11.7	10.0	17.2	3.4	2.8	4.4
Massey-Ferguson	83[a]	36	3.3	-59.6	6.4	1.2	-8.8	1.3
Allis-Chalmers	34	N/A	12.8	13.0	12.0	4.4	4.3	4.1
White Motor	33	96	0.1	0.0	2.1	0.1	-0.3	1.1
All Machinery, Except Electrical	--	--	16.7	17.6	16.9	7.6	7.6	7.1
All Motor Vehicles and Equipment	--	--	18.7	16.9	10.9	5.5	4.9	3.2
All Manufacturing Corporations	--	--	14.2	15.0	16.5	5.3	5.4	5.7

NOTES: [a]Includes industrial machines. N/A = Not available.

SOURCE: Liebenluft, Robert, "Competition in Farm Inputs: An Examination of Four Industries," Policy Planning Issues Paper, Federal Trade Commission (February 1981), p. 156.

The economies of scale in high volume machinery manufacturing have been documented, yet, the U.S. industry has not been able to utilize this cost advantage. In recent years, U.S. firms have not operated anywhere near the economic levels specified by the Royal Commission on Farm Machinery, yet overcapacity is a major problem plaguing the U.S. industry. Excess costs result from inefficient production, costly accumulation of excess inventories, and worker layoffs due to plant shut-downs and slow-downs.[33/] Industry analysts state that the farm machinery manufacturing industry is currently operating at 40% capacity, and farm equipment employment has dropped from 160,000 workers in 1970 to 90,000 at the present time.[34/]

On the positive side, the U.S. industry has taken measures to reduce costs in their manufacturing operations. For example, cost savings have resulted from joint-venture agreements with foreign firms, and through the positioning of certain manufacturing operations overseas by U.S. firms.

In terms of progressivity, the nature of competition of farm machinery industry has fostered technological development and innovation. Barber states that non-price competitive practices have greatly improved the quality of industry products over the past several decades. This improvement has allowed U.S. farmers to become some of the highest producing, and most cost-efficient producers in the world. However, not all innovation has been beneficial. In an industry such as farm machinery where output volume is often too small to benefit from economies of scale, emphasis on more sizes and options have added to the underlying cost of farm machinery. These costs, in turn must be absorbed by farmers.[35/]

33/ Rice, Faye, "Cruel Days in Tractorville," Fortune, October 29, 1984, pp. 30-36.

34/ "Farm Equipment Producers Face Fifth Year of Struggle." Minneapolis Tribune, November 18, 1984.

35/ Barber, Op. cit., p. 822.

At the dealer level, the industry has moved a long way towards efficient use of resources, reflected in the exit of unprofitable firms unable to capitalize on the economies of large-scale selling.[36/] To illustrate, in 1972 there were about 17,800 dealers. By the early 1980's this number had dropped to about 10,000.

One significant factor affecting the declining number of dealerships relates to the excess manufacturing capacity of the industry. With sales declining after 1979, manufacturers have been forced to shorten the terms of their floor planning agreements with dealers in an effort to liquidate excess inventories, and reduce carrying costs. This policy has placed additional financial pressures on dealers.

Sales and profitability data from a 1983 survey of farm machinery dealerships is shown in Table 11. The survey concluded that the largest volume dealers were more profitable than the smaller firms. Additional data shows net operating profits for small firms was .42%, as opposed to 1.27% for large volume dealers. These figures have deteriorated from 1979, when dealers earned a 3.7% average net operating profit before taxes.[37/]

MINNESOTA FARM MACHINERY DEALERSHIPS

Excess supply and decreased demand for farm machinery have had a similar effect on dealership closures in Minnesota in recent years. Minnesota Revenue Department shows dealerships have declined from 981 in 1975, to 710 in 1983, or a statewide decrease of 28%. Average sales volume for dealerships as well as

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36/ Ibid., p. 823

37/ "Cost of Doing Business Survey," National Farm Power and Equipment Dealers Association, 1983.

TABLE 11

SALES AND MARGINS FOR FARM EQUIPMENT DEALERS - 1983

Types of Sales	Average Amount	% of Total Sales	Margin (%)
New Equipment	983,281	46	8
Used Equipment	479,426	22	4
Repair Parts	450,964	21	31
Service Labor	153,739	7	42
All Other Lines	61,501	3	13
Retail-Lease Income	9,922	1	52
Average Total Sales:	2,138,833	100	14.76

SOURCE: National Farm Power and Equipment Dealers Association "Cost of Doing Business Survey", (1983).

total Minnesota retail sales also declined during this period.[38/] The changing numbers of Minnesota dealerships are shown in Figure 7.

The Survey

Given the declining number of dealerships, one of the main objectives of this study is to discuss and analyze some perceived changes in dealerships that may have accompanied this decline. With fewer dealers in business, it is hypothesized that surviving dealers are making adjustments (or have had to make adjustments) in their product line, the customers they serve, the geographic sales area they cover, and the levels of their inventory investment. In addition to verifying these perceived changes, the effect of imported machinery on these changes was analyzed.

To accomplish these objectives, a survey of 115 Minnesota farm machinery dealers was conducted. The survey consisted of three parts: (A) Total sales data and general information (B) New machinery sales with respect to types of machinery sold, types of customers serviced, geographic sales territory, and inventory data (C) Import sales data. Part C was dropped from the analysis because of insufficient data. The survey compared 1975 to 1983.

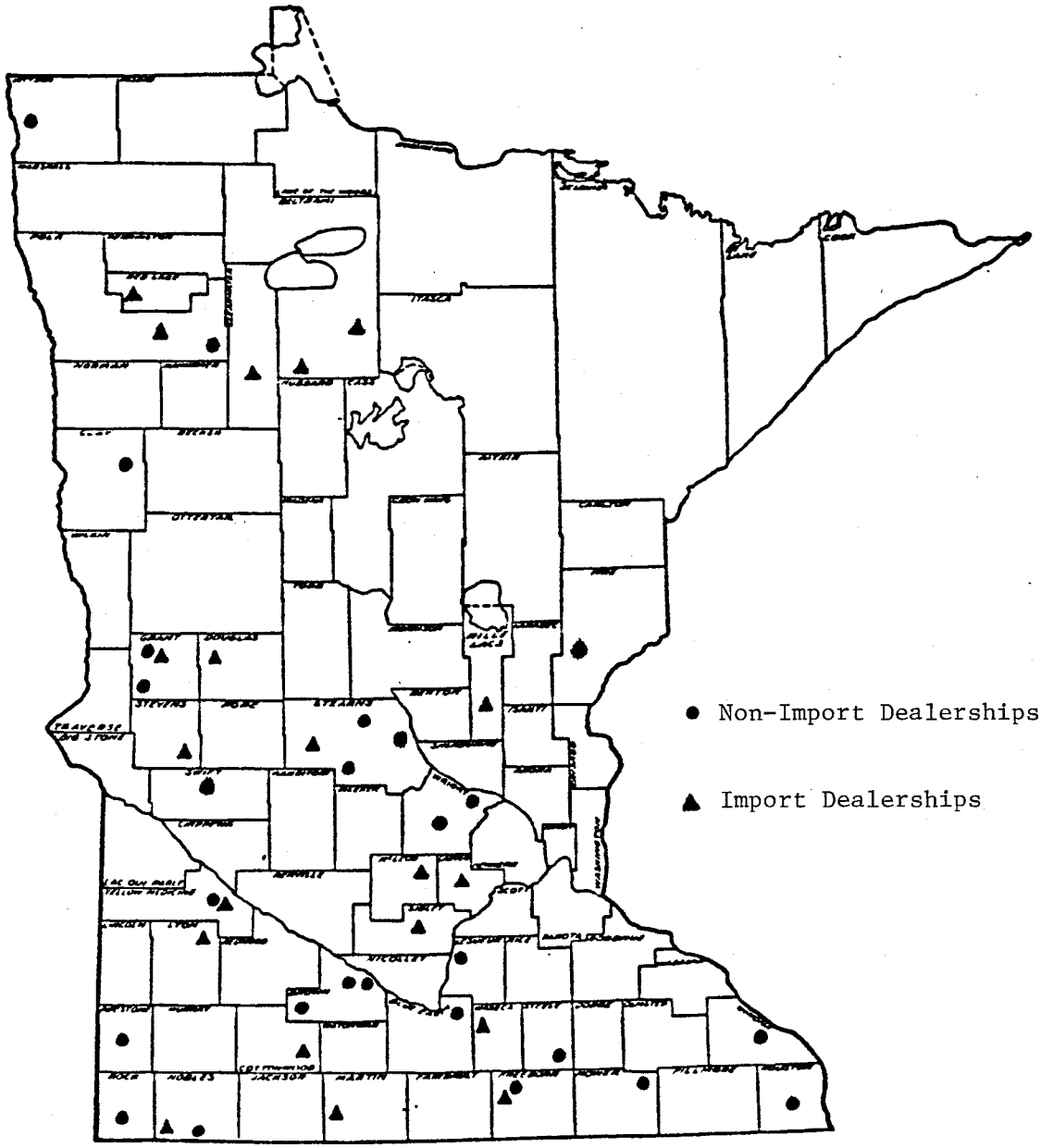
A total list of 765 retail firms was selected. Dealerships were then divided into two groups: those that sell imports (Type 1), and those that don't sell imports (Type 2).[39/] Of the 115 firms selected, 20 Type 1 firms, and 26 Type 2 firms responded. The location of participating dealerships is shown in Figure 8.

38/ This data was provided by the Minnesota Revenue Department (sales tax data for 1975 and 1983). The revenue data is in constant dollars, 1967=100.

39/ Imported products are defined as machines manufactured by a foreign-owned firm with a foreign brand label.

FIGURE 8

GEOGRAPHIC LOCATION OF DEALERSHIPS PARTICIPATING IN SURVEY



To verify the perceived changes in dealerships from 1975-1983, comparisons were made between 1975 and 1983 data. Paired t-tests were used on each group to test for significant changes within groups during this period.

To evaluate the impact of imports on dealerships, groups were tested for differences in 1975 and 1983. Group t-tests were used for this purpose. First, differences between groups in 1975, and differences between groups in 1983 were analyzed. Then, any change in the relationship between Type 1 and Type 2 dealerships from 1975 to 1983 was considered to be, at least partly explained by the efforts of imports. For example, in 1975 there was no significant difference between Type 1 and Type 2 dealerships with respect to geographic area served. However, in 1983 Type 1 dealerships were serving a significantly larger geographic area than Type 2 firms, implying that the growth in geographic sales area for Type 1 firms can be partly explained by the effects of import selling.

Analysis and Results of Survey

The analysis consisted of five sections: (1) total dealership sales data (2) distribution of new machinery sales (3) distribution of sales according to customer type (4) distribution of sales according to geographic region, and (5) inventory investment.

The changes in Type 1 dealerships are summarized in Table 12 by sections. Compared to 1975, the following changes were observed in 1983: a smaller percentage of total sales was new machinery; a smaller share of sales were to full-time farmers and a larger share to part-time farmers; the average geographic sales area increased with a smaller share of sales to nearby customers, and a larger share to distant customers; and decreased investment in parts and machinery inventories.

Table 12. Changes in Type 1 Dealerships From 1975-1983

		Avg. % of Total Sales 1975		1983		Change from 1975
Total Sales Distribution	New Machinery	47.8	(3.3)	41.5	(1.9)	smaller*
	Used Machinery	28.4	(4.7)	26.1	(2.8)	no signif. dif.
	Service	9.1	(1.9)	10.4	(1.7)	no signif. dif.
	Parts	12.9	(1.8)	16.3	(2.3)	no signif. dif.
	Leasing	.83	(.56)	3.3	(1.9)	no signif. dif.
	Other	1.0	(.56)	2.4	(1.1)	larger**
New Sales Distribution	Tractors/Implements	46.3	(6.5)	45.6	(7.2)	no signif. dif.
	Harvesting Machinery	35.1	(6.4)	32.3	(6.8)	no signif. dif.
	Handling Equipment	8.3	(2.8)	8.7	(2.8)	no signif. dif.
	Other/Misc.	10.4	(4.8)	12.3	(5.9)	no signif. dif.
Types of Customers	Full-time Farmers	82.8	(6.4)	78.5	(7.5)	smaller*
	Part-time Farmers	8.8	(2.8)	11.8	(2.7)	larger**
	Non-Farmers	8.3	(4.1)	9.8	(5.4)	no signif. dif.
Geographic Sales Area	0-10 Miles Away	43.8	(4.8)	32.1	(4.6)	smaller**
	11-20 Miles Away	33.3	(2.7)	32.5	(3.2)	no signif. dif.
	21-40 Miles Away	16.6	(3.1)	21.8	(2.4)	larger**
	> 40 Miles Away	6.3	(2.4)	13.6	(4.7)	larger*
	Avg. Distance	14.9	(1.4)	18.7	(1.8)	larger**

		1975 Avg.+	1983 Avg.	Change From 1975
Other Sales and Inventory Data	Total Sales	2,102,375 (669,492)	1,437,333 (416,499)	smaller*
	Parts Inventory	191,695 (38,579)	154,900 (29,284)	smaller**
	Machinery Inventory	980,270 (315,879)	826,818 (189,000)	none

Key:

* = Significant at .90
** = Significant at .95
\+ The 1975 data is inflated by the Producer Prices Index for Farm Machinery. (1967 = 100).

(Note: The standard errors are shown in parentheses next to the means.)

The changes in Type 2 dealerships from 1975 to 1983 are summarized in Table 13. Compared to 1975, the following changes were observed in 1983: new machinery constituted a smaller share of total sales, while parts, service and leasing shares increased; the over-all sales territory increased with a larger share of sales going to distant customers (40 miles away), and a smaller share with nearby (0-10 miles away) customers; the investment in parts inventory declined and total sales were smaller.

The effects of imports on dealership changes are summarized in Table 14. The table shows that import dealers: have increased their share of leasing and other (misc.) income relative to nonimport dealers; are doing a smaller share of their business with nearby (0-10 miles) customers, and more with distant customers (more than 40 miles away), and are serving a broader geographic area. No major import effects were observed on the distribution of products sold and customers served, and inventory investment.

Summary and Conclusions

The U.S. demand for small tractors has increased significantly during the past decade. At the present time, this demand has been filled almost exclusively by Japanese suppliers. In addition to these units, a large number of medium-sized machines are imported, mostly from Western Europe. Foreign penetration has occurred through the cooperation of U.S. firms. Almost all imported machinery is sold through joint-venture agreements with U.S. firms, or through direct-sell agreements with established U.S. dealerships. The cost and difficulty of establishing a strong dealership system imposes the largest barrier for foreign firms willing to enter the U.S. market at a more competitive level. For foreign firms to compete at a higher level with U.S. firms, they must work to establish a strong and reputable dealership network. This appears

Table 13. Changes in Type 2 Dealerships from 1975-1983

		Avg. % of Total Sales 1975		Avg. % of Total Sales 1983		Change from 1975
Total Sales Distribution	New Machinery	50.8	(2.7)	44.5	(2.5)	smaller**
	Used Machinery	23.1	(2.1)	23.8	(2.0)	no signif. dif.
	Service	7.6	(.68)	8.5	(.73)	larger*
	Parts	17.5	(1.5)	21.7	(2.3)	larger**
	Leasing	.14	(.10)	.46	(.19)	larger**
	Other	.64	(.41)	.64	(.48)	no signif. dif.
New Sales Distribution	Tractors/Implements	56.2	(3.8)	55.8	(3.8)	no signif. dif.
	Harvesting Machinery	28.1	(3.6)	24.8	(3.1)	no signif. dif.
	Handling Equipment	6.0	(1.5)	6.3	(1.7)	no signif. dif.
	Other/Misc.	9.6	(2.4)	13.0	(3.9)	larger*
Types of Customers	Full-time Farmers	84.1	(2.5)	84.0	(3.5)	no signif. dif.
	Part-time Farmers	11.5	(2.1)	12.2	(3.3)	no signif. dif.
	Non-farmers	4.4	(.90)	3.8	(.72)	no signif. dif.
Geographic Sales Area	0-10 Miles Away	52.5	(4.8)	47.3	(4.8)	smaller**
	11-20 Miles Away	29.1	(2.9)	29.3	(2.9)	no signif. dif.
	21-40 Miles Away	17.6	(3.9)	17.3	(2.2)	no signif. dif.
	> 40 Miles Away	4.2	(1.0)	6.1	(1.2)	larger**
	Avg. Distance	12.9	(1.0)	14.5	(1.0)	larger**

		1975 Avg. +		1983 Avg.		Change from 1975
Other Sales and Inventory Data	Total Sales	2,729,045	(278,186)	1,396,363	(179,809)	smaller**
	Parts Inventory	225,477	(26,688)	170,227	(23,485)	smaller**
	Machinery Inventory	929,363	(141,098)	885,227	(136,000)	no sig. dif.

Key:

* = Significant at .90
** = Significant at .95
\+ = The 1975 data is inflated by the Producer Price Index for Farm Machinery (1967 = 100)

(Note: The standard errors are shown in parentheses next to the means.)

Table 14. Changes in Dealerships Due to Import Effect

	Type 1 Compared to Type 2 in 1975	Type 2 Compared to Type 2 in 1983	Change
Total Sales	same	same	
New Machinery	same	same	
Used Machinery	same	same	
Service	same	same	
Parts	smaller*	smaller**	
Leasing	same	larger*	X*
Other	same	larger*	X*
Tractors/Implements	smaller*	smaller*	
Harvesting Machinery	same	same	
Handling Equipment	same	same	
Other/Misc.	same	same	
Full-time Farmers	same	same	
Part-time Farmers	same	same	
Non-Farmers	same	same	
0-10 Miles Away	same	smaller*	X**
11-20 Miles Away	same	same	
21-40 Miles Away	same	same	
> 40 Miles Away	same	larger**	X**
Avg. Distance	same	larger**	X**
Parts Inventory	same	same	
Machinery Inventory	same	same	

Key:

* = Significant at .90
** = Significant at .95

unlikely, unless foreign firms can acquire existing facilities from U.S. firms, and overcome the brand loyalties of U.S. farmers. A possible source of direct competition might be some of the European full-line firms or the Japanese tractor firms willing to manufacture and market large hp tractors. If the current import trends continue, the U.S. could experience an even wider farm machinery trade deficit in the coming years.

Similar to farm machinery manufacturers, the dealership system shows signs of becoming more concentrated. The changes occurring to Minnesota dealerships in light of decreasing firm numbers has been discussed. If this trend continues, it seems likely that dealers will have to make certain adjustments. If the number of full-time farmers continues to decline, and the number of part-time farmers continues to increase, dealers may find themselves doing a larger share of their business with the latter group. Also, as farm density decreases, dealers will invariably be dealing with fewer numbers of large-equipment-buying customers.

The results of this study are not conclusive. The implications of this study raise further questions, such as: what are the long-term effects of increasing imports on U.S. manufacturers? retailers? farmers? the U.S. economy in general? What is the likelihood of large-scale competition from foreign firms and who would these firms likely be? and, what are some of the implications of American dependence on foreign-sourced machinery? The findings of this study suggest that small tractor imports will continue to increase if small farms continue to grow in number. Manufacturers will continue to sell small tractors through joint-venture agreements wtih foreign firms as long as it is cost-effective for them to do so. However, the gradual increase in larger-sized tractor imports may indicate the possibility of foreign firms becoming more com-

petitive in the larger horsepower U.S. market, especially if these firms are able to establish reputable distribution systems and overcome the brand loyalty of U.S. farmers to U.S. firms. Further research in this area would be useful in understanding the implications of imported machinery.

REFERENCES

Bain, Joe S., Industrial Organization, (New York: John Wiley and Sons, Inc., 1959).

Barber, Clarence L., "The Farm Machinery Industry: Reconciling the Interests of the Farmer, the Industry, and the General Public," American Journal of Agricultural Economics, December 1973.

Cromarty, William A., "The Farm Demand for Tractors, Machinery and Trucks," Journal of Farm Economics, May 1959.

Gunjal, Kisan R. and Heady, Earl O., "Economic Analysis of U.S. Farm Mechanization," Card Report 119, Center for Agricultural Development, Iowa State University, 1983.

Heady, Earl O. and Tweeten, Luther G., Resource Demand and Structure of the Agricultural Industry, (Ames, Iowa: Iowa State University Press, 1963).

Implement and Tractor, "Keeping Pace with Changing Farm Size," January 1984.

Implement and Tractor, "What Makes Farmers Buy?," May 1983.

Kudrle, Robert T., Agricultural Tractors: A World Industry Study, (Cambridge, Mass.: J.B. Lippincott Co., 1975).

Liebenluft, Robert F., "Competition in Farm Inputs: An Examination of Four Industries," Policy Planning Issues Paper, Federal Trade Commission, February 1981.

Minneapolis Tribune, "Farm Equipment Producers Face fifth Year of Struggle," November 18, 1984.

Minnesota State Planning Agency, State Demographers Office, "Population Notes," August 1984.

National Farm Power and Equipment Dealers Association, "Cost of Doing Business Notes," August 1984.

National Farm Power and Equipment Dealers Association, "Future Planning Analysis - External Evaluation," August 1979.

Paul, Duane, Cost Economies of Scale in Input Marketing Firms with Special Reference to California Retail Farm Machinery Dealerships, University of California, Davis, 1976.

Rice, Kaye, "Cruel Days in Tractoville," Fortune, October 29, 1984.

United Nations Center on Transnational Corporations, "Transnational Corporations in the Agricultural Machinery and Equipment Industry," 1983.

U.S. Bureau of the Census, Census of Agriculture, 1945, 1950, 1954, 1959, 1964, 1969, 1974, 1978, and 1982.

U.S. Bureau of the Census, Department of Commerce, Current Industrial Reports - Farm Machinery and Lawn and Garden Equipment, 1970-1983.

U.S. Bureau of the Census, Department of Commerce, TSUSA - Imports for Consumption, Foreign Trade Report 246, 1970-1983.

U.S. Department of Agriculture - Economic Research Service, Outlook and Situation/Inputs: 1983, Washington, D.C., 1983.

U.S. Department of Agriculture - Economic Research Service, Outlook and Situation/Inputs: 1984, Washington, D.C., 1984.

U.S. Department of Agriculture Statistical Reporting Service, Farm Production Expenditures, 1971-1982.