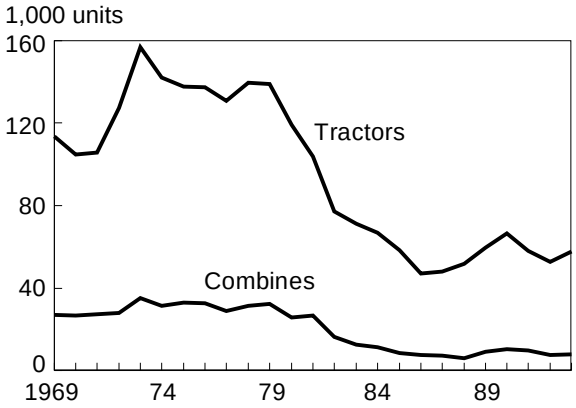
3.4 Farm Machinery

Farm machinery sales appear on the rebound after dropping in the mid-1980's. New conservation tillage equipment and tractors over 100 horsepower were in demand in 1993. Increased farm income, lower interest rates, higher asset values, and lower farm debt are contributing to renewed sales.

Farm machinery is essential to maintaining and increasing the productivity of U.S. agriculture. Farms in the United States are using more new, and increasingly complex, machinery. Farm machinery assets as a percentage of total farm assets increased from 8 percent in 1980 to 10 percent in 1992 (USDA, 1994c). Trends toward conservation tillage have prompted inventions such as the air drill and the coulter chisel and spurred machinery sales.

Farm machinery may have both beneficial and adverse effects on the environment. New electronically controlled pesticide sprayers, for example, reduce total quantities of pesticides applied by selectively regulating quantities where needed in the field. However, tractors and other heavy equipment cause problems with soil compaction in some parts of the country. Engine exhaust emissions are an adverse effect that will be reduced as EPA requirements are met for new tractors by the year 2000.

Figure 3.4.1
Farm tractor and combine sales, 1969-93



Tractors-40 HP and up and self-propelled combines.
Source: Equipment Manufacturers Institute.

Machinery Sales Appear on Rebound

After a sharp decline in the early 1980's, farm machinery sales appear on the rebound (table 3.4.1, fig. 3.4.1). Farm tractor sales rose from 52,800 units in 1992 to 57,800 units in 1993. Tractor and combine sales are indicators of the general farm machinery economy; retail sales data on other machinery are not available. However, another indicator that the farm machinery industry is improving is that it was at 64 percent of capacity in 1991, compared with 24 percent in 1986 (table 3.4.2).

Most factors affecting machinery demand favored increased equipment purchases in 1993. Farm income was up in 1992, and because machinery purchases tend to lag a year or more behind farm income, 1992 farm income was a positive factor toward purchases in 1993. The value of farm assets was up in 1992 and continued to increase in 1993. The debt-asset ratio dropped from 16.2 percent in 1992 to 16 percent

Table 3.4.1—Domestic farm machinery unit sales, 1986-93

Machinery category	1986	1987	1988	1989	1990	1991	1992	1993	Change 91-92	Change 92-93
	Units								*Percent*	
Tractors:										
Two-wheel-drive--										
40-99 hp	30,800	30,700	33,100	35,000	38,400	33,900	34,500	35,500	2	3
100 hp and over	14,300	15,900	16,100	20,600	22,800	20,100	15,600	19,000	-22	22
Four-wheel-drive	2,000	1,700	2,700	4,100	5,100	4,100	2,700	3,300	-35	22
All farm wheel tractors	47,100	48,400	51,700	59,700	66,300	58,100	52,800	57,800	-9	9
Self-propelled combines	7,700	7,200	6,000	9,100	10,400	9,700	7,700	7,850	-21	2

Source: Equipment Manufacturers Institute, Monthly Flash Reports.

in 1993. Interest rates continued to decline in 1993, another positive factor for increased purchases of farm machinery.

Tractor sales in the 40-99 horsepower category increased 3 percent in 1993 (table 3.4.1). Tractor sales in the 100-and-over horsepower category increased 22 percent. Purchases of four-wheel-drive tractors also increased 22 percent. Historically, when sales of all tractors increase, large (100-and-over horsepower) tractor sales go up proportionally more than the smaller (40-99 horsepower) category. The reverse occurs when total tractor sales are down. Farmers buy proportionally fewer large tractors when total sales decline. Demand factors were favorable for increased purchases of tractors and farm machinery in 1994 and purchases in the larger horsepower categories probably increased proportionally more than in the lower horsepower classes.

Combine sales were also up in 1993, compared with 1992. Combine sales increased by 2 percent in 1993, following a 21-percent decline in 1992 (table 3.4.1). Combine technology has improved significantly. Smaller, pull-type combines sold 30 years ago are not comparable to those sold today. Current sales figures report only self-propelled combines. Headers 25 feet and wider are now available. Bodies are wider, along with cylinders and concaves, to allow faster, more efficient threshing, at higher speeds. Harvesting quickly when crops are ready reduces crop loss due to adverse weather conditions such as hail, wind, and rain.

Table 3.4.2—Plant capacity, farm machinery, and equipment industry (fourth quarter)

Year	Capacity utilization rates[1]
	Percent
1980	62
1981	48
1982	31
1983	38
1984	41
1985	37
1986	24
1987	43
1988	54
1989	66
1990	66
1991	64

[1]For 1989 and later, percent of full production; for 1988 and earlier, percent of "practical capacity."

Source: USDC, 1994a.

Farm Economy and Other Factors Affect Demand

Demand for farm machinery is the result of many factors, including farm income, total value of farm assets, debt, interest rates, and acres cropped (see box, "Factors Affecting Demand for Farm Machinery"). Several farm sector economic factors, which started to improve in 1992 and continued to improve in 1993, encouraged increased capital investment.

Cash receipts for crops and livestock were up in 1992 and again in 1993 (table 3.4.3). Although crop sales dropped in 1993, partly due to the floods in the Midwest, higher livestock sales were more than offsetting. Net farm income, however, was down from $48.6 billion in 1992 to $46 billion in 1993 because of higher production expenses and changes in crop inventories. Lower farm income typically has a negative effect on farm machinery purchases, although the effect may lag several months. Prices of some commodities, such as corn and soybeans, rose in early 1994; higher prices tend to spur machinery purchases.

Both nominal and real interest rates are lower than they have been in several years. Lower interest rates have a positive effect on farm machinery investments. As interest rates fall, the total cost of machinery bought on credit decreases, making purchases more attractive. The real (adjusted for inflation) prime rate was 3.4 percent in 1993 (table 3.4.3). The prime rate correlates with the machinery loan rate, which has decreased every year since 1989. Nominal farm machinery and equipment loan rates were down to 8.7 percent in 1993 (6-percent real rate). While the real rate reflects the actual cost of borrowing, the nominal rate probably has more effect on machinery purchases because it is more obvious to farmers.

The value of farm assets was up both in 1992 and 1993 (table 3.4.3). Assets include both real estate and nonreal estate items. Nonreal estate includes machinery. Farm business assets were about $888 billion in 1993, an increase of $27 billion from 1992. Total assets will likely increase again in 1994, primarily due to increasing land values. Farm business debt, which has a dampening effect on farm machinery demand, was up about $2.7 billion in 1993, an increase of 2 percent. Farm equity (assets minus debt) increased, which meant more collateral to finance farm machinery loans.

A common indicator of the economic health of the farm sector is the debt-asset ratio. A lower debt-asset ratio

indicates a more favorable borrowing position. The ratio was 16 in 1993, lowest since the early 1960's.

Idled cropland also affects the demand for farm machinery—less idled acreage means more cropland to farm. Idled land totaled 77.7 million acres in 1988. By 1993, idled land had decreased to 56 million acres, effectively increasing farm machinery demand. As Conservation Reserve Program (CRP) contracts expire, more land will again be cropped.

Another factor that affects purchases of farm machinery is commodity exports. Commodity exports were $42.4 billion in 1992, up $4.8 billion from 1991 (table 3.4.3). In 1993, exports were up slightly to $43 billion, the highest in the last 5 years. Wheat, feedgrains, and oilseeds compose most of the commodity exports. The upward trend in commodity exports favors increased investment in farm machinery.

Not all economic indicators favor increased purchases. Farm machinery prices rose significantly the first 10 months of 1993 and again through April 1994 (table 3.4.4). Increases in farm machinery prices typically reduce demand. The October 1993 prices-paid index (1977=100) for tractors and self-propelled machinery was 237, 18

Table 3.4.3—Trends in U.S. farm investment expenditures and factors affecting farm investment demand, 1988-93

Item	1988	1989	1990	1991	1992	1993P
			$ billion			
Capital expenditures:						
Tractors	2.54	2.90	3.12	2.59	2.8	2.7-3.1
Other farm machinery	4.22	5.09	5.59	5.41	5.1	5.1-5.4
Total	6.76	7.99	8.71	8.00	7.9	7.8-8.5
Tractor and machinery repairs	4.02	4.51	4.37	4.48	4.2	4.2-4.6
Trucks and autos	2.36	2.58	2.62	2.39	2.3	2.3-2.5
Farm buildings[1]	2.39	2.53	2.80	2.75	2.4	2.3-2.7
Factors affecting demand:						
Interest expenses	14.3	13.8	13.3	12.1	11.4	11
Total production expenses	137.0	144.0	149.9	150.3	149.1	151
Farm business assets:						
Real estate assets[2]	595.5	615.7	628.2	623.2	633.1	657
Nonreal estate assets[2]	205.6	214.1	220.2	219.0	228.4	231
Farm business debt[2, 3]	139.4	137.2	137.4	138.9	139.3	142
Equity[2]	661.7	692.4	710.9	703.4	722.2	746
Agricultural exports[4]	35.3	39.6	40.2	37.6	42.4	43
Cash receipts	151.2	161.2	170.0	168.7	171.2	174
Net farm income	38.8	46.9	46.5	40.0	48.6	46
Net cash income	54.5	54.7	55.9	53.3	57.7	63
Direct government payments	14.5	10.9	9.3	8.2	9.2	13
			Million acres			
Idled acres[5]	77.7	60.8	61.6	64.5	54.9	56
			Percent			
Real prime rate[6, 7]	5.4	6.5	5.7	4.5	3.4	3.4
Nominal farm machinery and equipment loan rate[7]	11.7	12.8	12.3	11.3	9.3	8.7
Real farm machinery and equipment loan rate[6]	8.4	8.4	8.0	7.2	6.7	6.1
Debt-asset ratio[8]	17.4	16.5	16.2	16.5	16.2	16.0

P = Preliminary.

[1]Includes service buildings, structures, and land improvements.

[2]Calculated using nominal dollar balance sheet data, excluding farm households, for December 31 of each year.

[3]Excludes CCC loans.

[4]Fiscal year.

[5]Includes acres idled through commodity programs and acres enrolled in the Conservation Reserve Program.

[6]Deflated by the GDP deflator.

[7]Average annual interest rate. From the quarterly sample survey of commercial banks: Agricultural Financial Databook, Board of Governors of the Federal Reserve System (FRS, 1993).

[8]Outstanding farm debt divided by the sum of farm real and nonreal estate asset values.

Sources: USDA, 1994a, 1994b, 1994c, 1993b.

Table 3.4.4—Prices paid for trucks, tractors, and other farm machinery, 1980-94[1]

Year	Trucks and autos	Tractors and self-propelled machinery	Other machinery	Production items, interest, taxes, and wage rates
		1977 = 100		
1980	123	136	132	139
1981	143	152	146	151
1982	159	165	160	158
1983	170	174	171	159
1984	182	181	180	161
1985	193	178	183	156
1986	198	174	182	150
1987	208	174	185	152
1988	215	181	197	160
1989	223	193	208	167
1990	231	202	216	172
1991	244	211	226	175
1992	258	219	233	176
1993, Oct.	276	237	248	182
1994, Apr.	288	240	258	183

[1]Indexes are current, actual (undeflated) prices, weighted by the relative importance of component items that make up each individual category and converted to the base year 1977=100 (USDA, 1990).

Source: USDA, NASS, 1994, 1993a.

points above 1992. Prices for other machinery and trucks rose 15 and 18 points. However, the price index for all production items rose only 6 points, primarily due to declines in interest charges and other input items.

Summer 1993's excessive moisture and floods in the Midwest and Corn Belt reduced farm machinery demand in those areas. Some farmers could afford to replace equipment damaged by water. However, many put off replacing damaged equipment and survived by renting or borrowing until their situation improved. Farmers not affected by floods had late harvests due to wet fields, delaying planned machinery purchases. Rain and cool weather delayed the ripening of many crops, causing some to be damaged by early frosts. Some parts of the country, especially the Southeast, suffered from drought that likely slowed farm machinery purchases in those areas. However, offsetting these affected regions were many others with good weather and crop conditions.

Another factor affecting farm machinery demand is the new EPA regulation to limit exhaust emissions (FEMA, 1993). The regulations go into effect in 1996 for engines with 175-750 horsepower (HP), 1997 for 100-175 HP, 1998 for 50-100 HP, and the year 2000 for engines over 750 HP. The EPA proposes to limit nitrogen oxide emissions to 9.2 grams per kilowatthour and estimates that modifications to meet that standard would cost about $170 per engine. Standards may be set for hydrocarbon emissions once a suitable hydrocarbon testing procedure is developed.

Tillage Equipment Evolving

The 1985 Food Security Act requires farmers, with the assistance of the Soil Conservation Service, to identify highly erodible soils and develop conservation plans to keep soil erosion within acceptable limits (P.L. 99-198, 1985). These plans must be fully operational by 1995 for farmers to be eligible to participate in USDA's commodity program benefits.

One of the most cost-effective ways to reduce soil erosion is to leave crop residue on the surface of fields. Surface residue prevents soil erosion by slowing both water runoff and wind erosion. New tillage practices, many of which are still evolving, leave 30 percent or more of the previous year's crop residue on the surface. These practices include reduced tillage, conservation tillage, ridge till, and no-till. They all involve fewer tillage operations than conventional, moldboard plow tillage, which often buries crop residue.

Many farmers had already been practicing other forms of soil conservation, including grassed waterways, strip cropping, and terracing. But the 1985 Food Security Act appears to have been a major impetus for an array of new tillage equipment, as evidenced by ads in popular farm magazines promoting tillage, seeding, and planting equipment. Ads for plows, which used to be a primary tillage implement on farms, are now difficult to find. Farmers also adopt conservation tillage for economic reasons. Conservation tillage with fewer trips over the field can reduce tillage costs. Yields may increase due to moisture conserved by less tillage and greater residue cover.

Most new tillage equipment uses some type of fluted coulter to cut the residue for the disks or shanks that do the cultivation or seeding. Manufacturers, attempting to market new equipment, have come up with some uncommon nomenclature: trasheater,

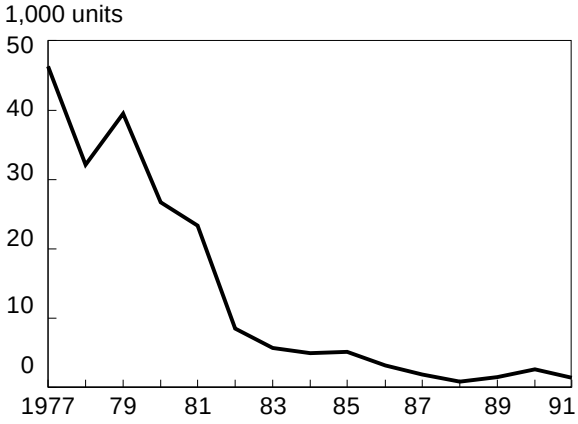
till/power, combo mulch finisher, triple-flex cultivator, mulch tiller, conservation disk chisel, total till cultivator, mulch-master, disc-ripper, diskovator, crustbuster grain drill, ridge till cultivator, and air drill, to name a few. Unfortunately, little data exist as to new equipment sales, prices, or imports and exports. The Department of Commerce (USDC) reports that the number of moldboard plows shipped by manufacturers dropped from 46,300 in 1977 to 1,400 in 1991 (fig. 3.4.2). Nomenclature and reporting by USDC and other agencies have not kept pace with innovations, making it difficult to tell the magnitude of trends in sales and prices.

The Census of Agriculture, taken every 5 years, reports on-farm inventories of trucks, tractors, and harvesting equipment, but not new tillage equipment. However, an indication of changing trends is evident from the yearly Cropping Practices Survey conducted by the National Agricultural Statistics Service, USDA. The 1992 survey of spring wheat practices in Minnesota, Montana, North Dakota, and South Dakota shows that about 6.5 percent of the total machinery complements consisted of reduced tillage equipment that had not been invented 10-20 years ago. Information is not available on imports and exports of new tillage equipment. However, few ads can be found for foreign manufactured conservation tillage equipment, which implies that imports may be small.

Machinery Purchases and Depreciation

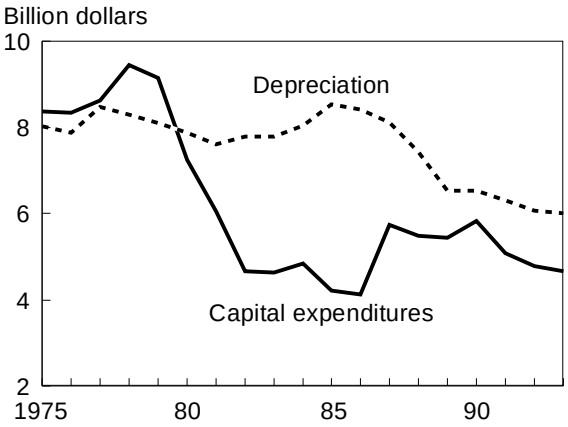
Depreciation of farm machinery has exceeded capital expenditures every year since 1980. This phenomenon, known as capital depletion, was most pronounced in the mid-1980's. In 1985, real depreciation reached $8.5 billion and real capital expenditures were $4.2 billion, a gap of $4.3 billion (fig. 3.4.3). The gap narrowed to $0.7 billion in 1990 and then increased again to $1.3 billion in 1992.

Figure 3.4.2
Manufacturers' shipments of moldboard plows, 1977-91



Source: USDC, 1992.

Figure 3.4.3
Machinery capital expenditures and depreciation, 1975-93



Adjusted to 1975 dollars. 1993 estimated.
Source: USDA, 1994c.

Capital depletion in agriculture results from several factors. For example, changing from conventional tillage to reduced tillage and no-till requires fewer passes over the field and prolongs machinery life. Also, the profitability of farming in the late 1970's encouraged farmers to buy more and larger tractors and machinery than needed. Farm tractor sales reached a high in 1973 with 157,000 units sold. When farm income declined in the early 1980's, farmers bought less machinery, but the farming sector remained productive by keeping old machinery in repair and using the extra capacity built up during the late 1970's. Although delaying expenditures on farm machinery can incur higher repair costs, there is usually a period of time when the difference in cost between keeping an old machine and buying a new one is small.

Eventually, capital investment will equal or surpass depreciation. Capital expenditures were catching up with depreciation in the late 1980's, but turned down again in 1991. As more farmers invest in the specialized machinery needed to comply with conservation plans, capital expenditures should again exceed depreciation. This trend may have started with increased capital expenditures in 1993.

Capacity Utilization

The farm machinery industry plant capacity was 64 percent in 1991 (table 3.4.2), compared with 24 percent in 1986. The low rate in 1986 followed several years of low demand for farm machinery and large dealer inventories. Total or full production capacity has decreased over the past decade as farm machinery manufacturers have cut back, consolidated, and combined in response to low sales and economic pressures. The same capacity utilization rate in the 1970's meant more production since full production for the industry was higher. Also, capacity utilization in the 1970's was higher, 83-85 percent throughout the 1970's as the farm machinery industry responded to high demand caused by high farm incomes, large exports, and high real estate asset values (USDC, 1994a).

Farm Machinery Trade

Total U.S. exports of farm machinery were an estimated $2.6 billion in 1993, up 18 percent from 1992 (USDC, 1994b). Imports for 1993, estimated at $2.1 billion, increased 4.1 percent from 1992. Thus, the United States had a trade surplus in farm machinery of $0.5 billion in 1993, up from $0.2 billion in 1992. Exports of farm machinery have exceeded imports for the last 3 years. According to the Department of Commerce, 1994 exports were expected to increase to about $2.7 billion, with imports remaining about the same as in 1993. About one-third of the farm machinery manufactured in the United States was exported in both 1992 and 1993 (USDA, 1993b).

The biggest trading partner for both imports and exports of farm machinery is Canada. Other major export markets include Mexico, Saudi Arabia, Spain, France, and Japan. Exports, as a percentage of U.S. shipments, have gradually increased since 1989.

More than 60 percent of U.S. farm machinery imports are tractors and parts, mostly for tractors below 100 horsepower. Major suppliers of imports are Canada, Mexico, Germany, Italy, the United Kingdom, and Japan. Nearly one-fourth of all farm machinery sold in the United States was imported in 1992 and 1993. Imports, as a percentage of domestic supply, remained at 22-23 percent from 1989 to 1992, dipping to 19 percent in 1991.

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Factors Affecting Demand for Farm Machinery

Real estate assets--Land and service structures. Increasing assets place a farmer in a more favorable position for obtaining capital investment loans. Balance sheet components are now reported by the Economic Research Service (ERS) on a "farm business" basis (Erickson and others, 1993; USDA, 1994b). ERS used to report two versions of assets and debt, one "including" and one "excluding" farm households. The series that excluded households was similar to the new farm business series on assets and debts. The "including households" series was often used as an indicator of farm machinery demand because lenders look at a farmer's total assets and debt when considering loan applications. The growth in importance of off-farm income has made it more difficult to separate farm household accounts between farm and nonfarm activities and prompted the shift to the farm business series. Since the "including" and "excluding" households accounts closely paralleled each other, the new business series would likely make little difference when used as a demand factor for forecasting farm machinery investments.

Nonreal estate assets--Includes livestock, crops, machinery, motor vehicles, and financial assets.

Farm business debt--Real estate and nonreal estate debt.

Equity--Total assets minus debt. Farm equity represents a farmer's net worth; the greater the equity, the more collateral the farmer has available to back loans for capital investment.

Interest expenses--Interest on both real estate and nonreal estate debt.

Farm machinery loan rate--Average annual interest rate as reported in the quarterly survey of commercial banks by the Federal Reserve System (FRS, 1993). An inverse relationship exists between interest rates and the purchase of farm machinery. Lower interest rates imply greater purchases of farm machinery.

Real prime rate--Bank prime rate, adjusted for inflation by gross domestic product deflator.

Debt-asset ratio--Farm business debt divided by farm business assets. Lower debt/asset ratios mean more favorable borrowing positions and, likely, more investment in tractors, combines, and other farm machinery.

Cash receipts--Sales of all crop and livestock commodities. Cash receipts are like "money in the pocket" and correlate closely with purchases of farm machinery.

Total production expenses--Total of cash expenses (inputs purchased, such as feed, seed, fertilizer, pesticides, fuel, repairs, custom work, and labor; interest; rent; and property taxes) plus noncash expenses, which include capital replacement and accidental damage.

Net cash income--Gross cash income (cash receipts, direct government payments, and farm-related income) minus cash expenses.

Net farm income--Gross cash income, nonmoney income, and inventory adjustments minus total production expenses. Net farm income has a high correlation with machinery purchases when purchases are lagged several months behind income.

Agricultural exports--Exports of U.S. agricultural products (fiscal year October 1 through September 30) (USDA, 1994a).

Idled acres--Cropland idled through commodity programs and enrolled in the Conservation Reserve Program. More land idled means less cropland to be cultivated, seeded, and harvested. Machinery is used less, prolonging useful life.