AN ECONOMIC ANALYSIS OF USED FARM MACHINERY VALUES

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ABSTRACT

AN ECONOMIC ANALYSIS OF USED FARM MACHINERY VALUES

by David L. Peacock

It is quite well known that common depreciation methods are poor estimators of used machinery values. Yet they continue to be used for this purpose due to a shortage of better information. It was the lack of such information which prompted this study.

The objectives of this study were to: (1) discover how used farm machinery values change over time, and (2) learn what factors affect these values.

Various models were developed involving variables which were hypothesized to have an effect on the market value of used farm machinery. Each model was tested by least squares multiple regression methods using the Official Tractor and Farm Equipment Guide "as-is" values to represent market values. Equations were computed for farm tractors, combines, forage harvesters, balers, and cornpickers. These machines were all studied over a ten year time span, 1953 through 1963, using 1953 models and a five year time span, 1958 through 1963 using 1958 model equipment. Every equation based on the "current" dollar value of the used machine was duplicated by an equation using "real" dollar (deflated) values as the dependent variable.

As might be anticipated, age of the machine was the most important variable. Alone, it was capable of explaining from 57% to 89% of the variation in used machinery values. Curvilinear models demonstrated that the rate of "loss-in-value" associated with age declines as the machine becomes older.

Realized net farm income, lagged one year, seemed to have little or no effect on the demand for used farm equipment. This was also true of farm prices, as measured by the USDA prices received by farmers index.

It was somewhat surprising to find that it was impossible to obtain a consistent 1-2-3---n ranking of the different makes of machinery. Consequently the information provided by these variables is of little general use in predicting used values, even though it was extremely helpful in explaining them.

A variable designed to measure the effect of the introduction of new models on the used value of older models did not produce any consistent results. The acreage of crops harvested (combined acreage, and corn acreage)and livestock numbers seemed to have no significant effect on the used values of combines, cornpickers, forage harvesters, and balers.

There was a significant difference in the rates of "loss-in-value" for gasoline and diesel tractors, and for pull type and self propelled combines. Less important technical differences, such as wire as opposed to twine-tie balers and pull type as opposed to mounted cornpickers, had no recognizable effect on used values.

A comparison of the equations based on "current" dollars with those using "real" dollars indicated that inflation had a considerable effect on used farm machinery values.

The estimated used values obtained from the regression equations were, of course, quite different from those calculated using common depreciation schemes. (1) The initial (first year) drop in machinery values tended toward or exceeded the maximum depreciaton allowed by the Internal Revenue Service. (2) The so-called "salvage" value (at ten years of age)in current dollars, was estimated to be considerably greater than the traditional assumption of 10%. (3) Yearly "loss-in-value" (with the exception of the first year) is usually less than assumed by depreciation schemes.

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CHAPTER I

THE PROBLEM

Current agricultural production is increasingly dependent upon the services of farm machinery. In the past two decades we have witnessed considerable growth in the use of farm machinery, and a simultaneous decline in the size of the farm labor force. From 1940 through 1960 the number of trucks and tractors used by farmers more than doubled, grain combines increased to more than five times their 1940 level, and corn pickers (including picker shellers) expanded to greater than seven times their earlier number.[1/] In this same span of time the size of the farm labor force fell from nearly eleven million workers to slightly over seven million. (This trend toward fewer farm workers is continuing in the 1960's.)[2/] Further the total number of farms dropped from 6,350,000 in 1940 to 3,949,000 in 1960,[3/] while total acreage devoted to farm use was slightly larger in 1960.[4/] The unavoidable

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1/ U.S. Department of Agriculture, Farm Cost Situation, FCS-35 November 1963, p. 15.

2/ U.S. Department of Agriculture, Farm Cost Situation, FCS-36, November 1964, p. 11.

3/ Ibid., FCS-35.

4/ Land in farms increased from 1940 to 1950, 1,061 million acres to 1,159 million acres, and declined to 1,120 million acres by 1959; see U.S. Department of Agriculture, Agricultural Statistics 1963, p. 435.

conclusion is that fewer farmers are operating larger farms and depending upon increased use of farm machinery to accomplish the task.

Although the trend toward greater numbers of farm machines has tended to level off since 1960 and in some cases show slight reductions, the concurrent trend toward larger capacity and more complicated machinery continues.

Another approach to indicating the importance of farm machinery in modern agriculture is to illustrate how it fits into the financial structure and operation of the individual farm businesses. In 1963 the depreciated value of farm machinery inventories averaged 12.7 percent of the total farm investment for cooperators of the Michigan Mail-In Record Project. (The range by types of enterprises is from an 8.98 percent average for beef-hog operations to a 17.82 percent average for dairy and potato combinations.)[5/] This same group of farmers averaged annual farm machinery ownership costs, as measured by the depreciation taken, of $2,682 or roughly nine percent of their total farm expenses. When one adds the average cost of operating the machinery (gas, oil and maintenance) amounting to $2,611 to the ownership costs, (as

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[5/] Computed from information presented by Leonard R. Kyle in Michigan Farm Business Report for 1953 (Michigan State University Experiment Station; Research Report No. 30)p.3.

specified above--excluding any interest payments) their annual machinery expense turns out to be $5,293, or nearly 17.5 percent of total farm expenses.[6]

While the above figures are impressive, they undoubtedly do not represent an accurate statement of either the average value of the cooperators' farm machinery investment or their machinery ownership expenses. This is because the figures reported were computed using common depreciation methods. These methods tend to yield estimates of farm machinery values which differ considerably from their market values. Table 1 illustrates the divergence between market values and those computed by depreciation schemes. Despite the evident inadequacies of depreciation schemes for this purpose, little seems to have been done toward developing improved methods of estimating used farm machinery values. It was the lack of such information that prompted this study.

The study explores how used farm machinery values change over time and considers certain variables that were expected to effect these values.

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[6] Ibid., p. 8.

CONTRIBUTION OF THE STUDY

It would seem appropriate to establish the usefulness of this study before progressing very far. The following, therefore, suggest some applications of improved information about used farm machinery values.

Farm Planning.

The farmer could use this type of information to improve his estimates of the cost of owning and operating farm machinery. These improved cost estimates in turn could be used in a number of planning and budgeting situations. Where machinery costs are important production expenses, more accurate comparisons of alternative enterprises could be made. Applied directly to farm machinery; improved decisions could be made with respect to determining the profitability of owning a given machine, the proper complement of machinery for a given farm situation, whether to buy new or used equipment, and when to trade.

Tax Purposes.

The income tax law has recently been changed to prevent farmers from considering the excess of the disposal value of farm machinery over their depreciated value as capital gains.[7]

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[7] For additional information see the Farmers Tax Guide, U.S. Internal Revenue Service.

TABLE 1.--Differences between the market value and values estimated by common depreciation methods for a used 1953 "Super M" Farmall Tractor. (Percentage values represent the differences of depreciation values from the market values.)[a]

Year	Straight Line		Straight Line + 20% Add. 1st yr. dep.		Declining Balance		Declining Bal +20% Add.1st. Yr. Dep.		Sum of Digits		Sum of Digits + 20% Add. 1st Yr. Dep.		Market Value
End of 1st yr.	$2359	+31%	$1938	+8%	$2074	+16%	$1659	-8%	$2168	+21%	$1786	-0%	$1794
End of 4th yr.	1660	+23%	1377	+2%	1062	-21%	849	-34%	1150	-14%	973	-28%	1346
End of 7th yr.	961	+26%	816	-38%	544	-59%	435	-67%	514	-61%	464	-65%	1313
End of 10th[b] yr.	262	-79%	259	-79%	279	-77%	227	-81%	260	-79%	260	-79%	1226

a. Percentage differences = $\frac{\text{depreciation value-market value}}{\text{market value}}$

b. 10th year represents the salvage value of the tractor--differs due to rounding error or method of calucation.

c. Depreciation was computed using a 10 percent salvage value--except for declining balance where salvage value is not applicable.

d. Market values from the source used for this study---
National Farm and Power Equipment Dealers Association, Official Tractor and Farm Equipment Guide, (St. Louis; NRFEA Publications, Inc., 1953-1963, Eds.)

Farmers may find improved estimates of farm machinery values useful in planning the depreciation of these assets.

Farm Management Research

Researchers could use improved information about machinery values where they are an important part of budgeting or programming studies. Such information would, of course, be particularly applicable to studies of the economics of farm machinery use.

Agricultural Credit Agencies

Agencies supplying credit for farm machinery purchases may well be interested in using this type of information to design repayment plans and maturities that would better serve their customers.

OBJECTIVES

The objectives of this study are as follows: (1) discover how used farm machinery values change over time, (2) to learn what factors affect these changes in value.

PROCEDURE

Briefly the procedure used in this study was to: (1) locate a reliable source of market values for used farm machinery, (2) obtain values for selected machines over five and ten years time span, (1958-1963, 1953-1963 respectively,) (3) develop a model relating the hypothesized factors to the market values of the machines selected, (4) test the model (by least squares multiple regression methods), and (5) analyze the result.

CHAPTER II

DATA AND METHOD OF ANALYSIS

Chapter I pointed out the inadequacy of current depreciation schemes as estimators of the market value of used farm machinery. In addition, the objectives of this study were listed. This chapter discusses the source of data and the method employed in analysis of this data.

Data

The objectives of this study presuppose the need for a sizeable quantity of reliable "market value" data for used farm machinery. The possibility of obtaining these data from primary sources was quickly dismissed. The cost of surveying a sufficiently large number of farmers and farm machinery dealers would have been prohibitive. It is also questionable that accurate data could have been secured for years other than the present.

Thus, locating a secondary source of data was necessary. Two sources of such data were available: National Farm Tractor and Implement Blue Book Valuation Guide published by National Market Reports, Inc., and Official Tractor and Farm Equipment Guide compiled by National Farm and Power Equipment Dealers Association (hereafter referred to as Blue Book and Official Guide).

However, the estimates of market value given by the above sources are not comparable. The following table illustrates the disparity between the two.

TABLE 2.---1966 Market Values of selected used tractors taken from Official Guide and Blue Book. (The "as-is" value is the market value of the stated tractor in average condition.)

Year	Model	Official Guide "as-is"	Blue Book "as-is"
1947	Farmall "H"	$ 333	$---[a]
1953	Farmall "Super M"	947	---
1954	Ford "NAA"	700	---
1955	John Deere "60"	1062	---
1956	Allis Chalmers "WD45"	1004	850
1957	Oliver "Super 77"	1036	875
1958	Case "300"	988	735
1959	Oliver "880"	1934	1500
1960	Massey-Ferguson "65"	1730	1650
1961	John Deere "3010"	2335	1615
1962	Massey-Ferguson "85"	2364	2410
1963	Farmall "504"	2156	2285
1964	Ford "6000"	2621	2700
1965	Minneapolis Moline "M-604"	4520	4900

[a]Blue Book does not give "as-is" values for Tractors over 10 years of age.

The publisher of Blue Book contends in the statement below, that any disparity between their figures and those of another reputable source is more apparent than real.

> VALUATION COMPARISONS--Valuation figures appearing in the Blue Book are as a rule lower than the valuations given in one of the leading reference guides for dealers. This sometimes leads to the mistaken belief that Blue Book figures do not represent a true picture of used tractor and farm equipment values. A careful comparison of the two sets of figures, however, reveals that the higher valuations given in the reference guide are due to the addition of various special equipment items not included in the regular Factory List Price. Such extras may, or may not, actually be wanted by the individual who is interested in the machine. They frequently result in an increase of several hundred dollars, and in the case of larger tractors, well over a thousand dollars in the indicated list price with an attendant increase in the valuation figures. Blue Book valuations, on the other hand, are based wholly upon the manufacturer's Factory List Price which includes regular equipment only. This is a more accurate and logical base price to use, since the tractor component parts are always standard and uniform for all sections of the country. Where special equipment items are taken by the original purchaser, the price of such extras should be added to the Factory List Price and properly adjusted in the valuation tables.[8/]

It is the author's observation that Blue Book normally does use the most basic model, while Official Guides valuations are for models including certain supplemental equipment.

8/ National Market Reports, Inc., National Farm Tractor and Implement Blue Book Valuation Guide, (Chicago, Ill., 1966), p.3.

Official Guide states their case as follows: "Values published herein for tractors and other machines include factory options and extras normally sold by dealers, nationwide, as part of original equipment."9/ Blue Book suggests that correction of their values to include optional equipment can be made using the following table.

TABLE 3.---Percentage figures, suggested by Blue Book, to determine the depreciated value of optional equipment not included in the model specifications--1966 edition.10/

1965 Current Year	1964 1 Year Old	1963 2 Years Old	1962 3 Years Old	1961 4 Years Old	1960 5 Years Old
80%	70%	55%	45%	35%	25%

[a]This table was reproduced exactly as it was found in the 1966 edition of Blue Book. The author finds this table somewhat confusing. For example, does "current year" under 1965 refer to 1965 or 1966? If, in fact, it refers to the depreciated value of 1965 optional equipment in 1966 it should be labeled 1 year old (and "five years old" then actually refers to equipment six years old). However, if it refers to the value of the equipment in the "current year" it should be under 1966, not 1965. The author assumes that what is meant by "current year" is actually 1 year old and similarly for the other labels.

9/National Farm Power and Equipment Dealers Association, Official Tractor and Farm Equipment Guide, (St. Louis, Missouri, Spring 1966) p.3.

10/Blue Book, p.3.

The method of correction is to multiply the original cost of the "extra" equipment by the percentage of its value remaining, as given in Table 3, and adjust the "as-is" value by this amount.

Although these corrections improve the comparability of the two sources, disparity still exists (See Table 4.) Note that the largest differences seem to be in the earlier models.

TABLE 4.--Official Guide market values and Blue Book market values corrected to provide valuations for selected tractors with given model specifications----1966 editions.

Year	Model	Official Guide "as-is"	Blue Book Corrected Value
1956	Allis Chalmers "WD-45"	$1004	$ 850
1957	Oliver "Super 77"	1036	916
1958	Case "300"	988	776
1959	Oliver "880"	1934	1759
1960	Massey-Ferguson "65"	1730	1650
1961	John Deere "3010"	2335	1918
1962	Massey-Ferguson "85"	2364	2410
1963	Farmall "504"	2156	2285
1964	Ford "6000"	2621	2700
1965	Minneapolis Moline "M-604"	4520	4900

An alternative method of testing the assertion that "extras" are responsible for the differences in valuations given by the

two sources is to determine the new value of optional equipment necessary to make Blue Book "as-is" values equal to those given by Official Guide. The method used for this determination was to divide the difference between "as-is" values for a given tractor by the appropriate percentage figure from Table 3. This was done for two popular 1954 tractors and the results appear in Table 5.

TABLE 5.--Market values for 1954 Farmall "Super M" and 1954 John Deere "60" from 1957, 1958, 1959 editions of Official Guide and Blue Book, and the new value of optional equipment necessary to equate used values from the two sources.

Year	Official Guide	Blue Book	Value of Required Extra Equipment
	1954 Farmall "Super M"		
1957	$1510	$1345	$ 300
1958	1475	1195	622
1959	1449	1040	1168
	1954 John Deere "60"		
1957	$1534	1270	$ 480
1958	1415	1160	566
1959	1368	965	1151

Since the total possible value of optional equipment for the 1954 Farmall "Super M" was $486.00 and for the 1954 John Deere "60" was $579.00[11] as contrasted to necessary options valued in excess of $1100.00, differences in equipment does not seem to provide an adequate reconciliation of the two sources.

Thus, the overall conclusion is that the data are different and the immediate job is to select between them. The choice for this study is the Official Guide. This is based mainly upon conclusions about how the valuations were compiled, while there are other minor considerations (to be discussed later). The most pressing concern is that the data must be reflective of "market values". The conclusion here is that the valuations printed in the Official Guide are derived empirically, based on the reported experiences of farm machinery dealers, and therefore should be a fairly accurate portrayal of the "market values" desired. The Blue Book, however, is somewhat nebulous about how their valuations are derived and it appears that they may be based on a mathematical formula with adjustments for the judgement of the publishers.

The Official Guide receives reports from farm machinery dealers semiannually and processes them to be used by the industry in the following period.

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[11] Computed from information found in Spring 1965 Edition of National Farm Power and Equipment Dealers Association, Official Tractor and Farm Equipment Guide, pp. 113, 163.

The values quoted herein...are based upon reports of thousands of sales....These reports come from representative dealers handling all makes of agricultural tractors and allied equipment.

Since the values quoted herein are based upon prevailing retail sales prices of used equipment, they are assumed to be accurate and dependable. 12/

The method of processing these reports into published "as-is" values is given below:

1) Retail prices for each make and model are averaged.

2) The average cost of reconditioning the equipment is computed.

3) Average reconditioning cost is subtracted from the average retail price.

4) Twenty percent is deducted from the remainder. (This is to cover dealer overhead and profit.)

5) The resulting "as-is" figure represents what a machine in average repair is worth to the dealer.

Example:	Average resale	$800
	Average cost of reconditioning	-55
		745
	Minus 20 percent of 745	-149
	Average as-is	
		$596

If the farmer is able to perform the reselling services of the dealer, the farm equipment in question may be worth more than the Official Guide as-is value. For this study, however, it is assumed that farmers as a whole do not make a practice of reselling their own equipment or if they do, the price obtained is somewhere near the as-is value. This

12/ Official Guide, 1966, p. 1.

assumption may bias the results downward slightly, but such an error is believed to be more than offset by the advantages of using this rather easily available market value. Unquestionably the use of average retail prices would be unrealistic (would assume that all machines on farms are in "good saleable condition") and the resultant upward bias would be considerably more damaging to the study.

Blue Book makes no clear-cut explanation of how they arrive at their valuations. In reply to my inquiry, J.F. Heffinger, President of National Market reports, Inc., which publishes Blue Book writes:

> The manner in which we arrive at the "as-is" value is generally defined in our "Introductory Section." As is true of all of our valuation guide books, the arrival at valuations is not a science, but an art. There are, of course, basic criteria, such as production volume, general acceptance, bank and insurance company experiences. They of course, become a function of the ultimate values placed in our guide book. 13/

As suggested, one might look to the "Introductory Section" of Blue Book for clarification of their procedure. This is not particularly fruitful, however, as the following statements illustrate.

13/ Taken from a letter to the author from J.F. Heffinger, president of National Market Reports, dated January 19, 1965.

1956 Edition---

Careful planning, analysis and research are employed in the preparation of the various guides we have published for years, among others, the Red Book and Blue Book Used Car Appraisal Guides. The same analytical approach and time tested methods, together with a thorough study of thousands of sales reports from farm implement dealers, have been used in the preparation of the material for this edition.[14/]

1966 Edition---

Government figures show that the average life of a tractor is approximately 12 years. The rate of yearly depreciation used in computing Blue Book valuations corresponds to this figure. It follows the accepted sliding-scale pattern advocated in government publications and widely used in various state assessment offices. Blue Book valuations are also checked against average prices prevailing at regional auction sales. [15/]

The results of three simple linear regression equations leads the author to conjecture that Blue Book used a formula as the basis for some of its valuations (and therefore would not provide useful data for this study). A regression of "as-is" tractor values (in percent of new cost) on tractor age was calculated for two popular 1954 models for the years 1955 through 1959. Then a similar regression was calculated for the combination of the two models. The results are given in Table 6.

[14/] Blue Book, 1956, p. 2.

[15/] Blue Book, 1966, p. 4.

TABLE 6.--Linear Regression of the percentage values of selected 1954 tractors--obtained from Blue Book--on tractor age.

Model	Equation	R^2
1954 "Super M"	$\hat{Y} = 69.97 - 5.81\ X_1$	.9922
1954 "60"	$\hat{Y} = 69.58 - 5.94\ X_1$	.9918
Combination	$\hat{Y} = 69.77 - 5.87\ X_1$	.9892

where $\hat{Y}$ = Estimate of percentage value

X_1 = Age, given by 1955=1, 1956=2,----1959-5

Note the very high R^2's which mean that a straight line is nearly a perfect fit to the data. The uniformity of the equations suggest that the formula $Y = 70.0 - 6.0X_1$ could be used to compute values,---for the given tractors--nearly duplicating the "as-is" values from Blue Book.

In addition to evidence that Official Guide is more representative of "market values," it has the advantages of (1) being more often recommended by individuals concerned with the farm machinery business and (2) being more complete and easier to use than Blue Book.

Method of Analysis

The first step toward analyzing the data was to convert the "as-is" values to percentages of the original value. The original value was designated as equivalent to the new cost to the farmers.

Discussions with branch offices of the farm machinery manufacturers and their local dealers revealed that the initial bargaining price to the farmer was the factory f.o.b. price (as reported in Official Guide) plus allowances for freight charges and excise taxes. No effort was made to take into consideration freight charges and excise taxes as they vary from area to area. It was assumed that the resultant upward bias of the values does not warrant the effort necessary to attach average freight and excise taxes to each f.o.b. prices. Secondly, it was assumed that local dealers normally sold machines below the f.o.b. price. The dealers interviewed agreed that a 5 percent discount from f.o.b. price would be typical in 1953, further than 5 percent to 7 percent would be reasonable for 1958 and figures from 5 percent to 10 percent were appropriate currently. The percentage values used in this study were computed by reducing the f.o.b. price by 5 percent and dividing the resultant "new cost" into the value given for each year.

Example: 1953 "Super M" Farmall

$2728 (f.o.b. 1953) x (5%) = $136

$2728 - $136 = $2592 (Assumed "New Cost" to the farmer)

(1954 $ value) $1794 ÷$2592 = 69.2% (of "New Cost")

(1958 $ value) $1386 ÷$2592 = 53.5%

(1963 $ value) $1226 ÷$2592 = 47.3%

It was readily apparent that a graphical analysis was not sufficiently powerful to meet the objectives of the study. From both the data and simple graphical presentation, one observes differences between years, make of machinery and models. (See Table 7 and Figure 1 on the following pages.)

It is evident that variables other than age should also be considered. The method of analysis employed must then accommodate multiple variables and have the capacity to test their significance. Again, it must give some measurable estimate of the effect of individual variables on the percentage values. A model to which least squares multiple regression could be applied seemed to meet these requirements.[16/] In addition, the results can be put in a form that is reasonably easy to understand by farmers and others who may wish to use them.

Not all of the equations computed are reported in the text that follows. In general, the equations selected were required to meet the following criteria: (1) The variable in question (those unique to the specific equations) must make a significant contribution to the fit of one or more of the equations including it as part of the model.

[16/] For an understanding of multiple regression, one can look to any of a number of standard statistic textbooks, including: George W. Snedecor, Statistical Methods, (Ames, Iowa, 1957, Iowa State College Press.)

(2) And the overall statistical results, related to the given variable, must be explainable in theoretical terms. In other words, they must be indicative of a reasonable economic "cause and effect" relationship.

The inclusion of several equations involving new model variables (explained in the Chapter III) is somewhat of an exception to the second criterion. These equations were included to indicate the likelihood of a relationship which the variable in the particular form used, did not adequately measure.

The used farm machinery values in this study were for the periods 1953 through 1963 (1953 models) and 1958 through 1963 (involving 1958 models.) At the outset of the study, used values for the year 1963 were the most recent data available. The ten year span of 1953 through 1963 was then chosen to conform with length of time usually associated with depreciation, (as used for income tax purposes) under the assumption that the most recent experience would be most relevant. The choice of the ten year span, as might be expected, was to make comparisons of the statistical results and common depreciation schemes as easy as possible. The shorter period of time, 1958 through 1963, was used to test the validity of the findings of longer period, and to identify any trends or changes in used values that might be associated with later model equipment.

TABLE 7.--Dollars value and percentage value[a] for 1953 Farmall "Super M" and 1953 John Deere "60" tractors.[b]

Model	1953 (new cost)c	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
John Deere	$2351	1824	1493	1522	1422	1306	1237	1412	1335	1254	1163
"60"	%---	77.6	63.5	64.7	60.5	55.6	52.6	60.1	56.8	53.3	49.5
Farmall	$2592	1794	1508	1509	1346	1386	1328	1313	1293	1203	1226
"Super M"	%---	69.2	58.2	58.2	51.9	53.5	51.2	50.6	49.9	46.4	47.3

[a] Percentage values are determined by dividing the used value by the new price.

[b] The curious phenomenon of a tractor being worth more than it was a year earlier is not an error in the table.

[c] New cost is the f.o.b. price minus 5 percent---what farmers probably would have paid for the tractor in 1953.

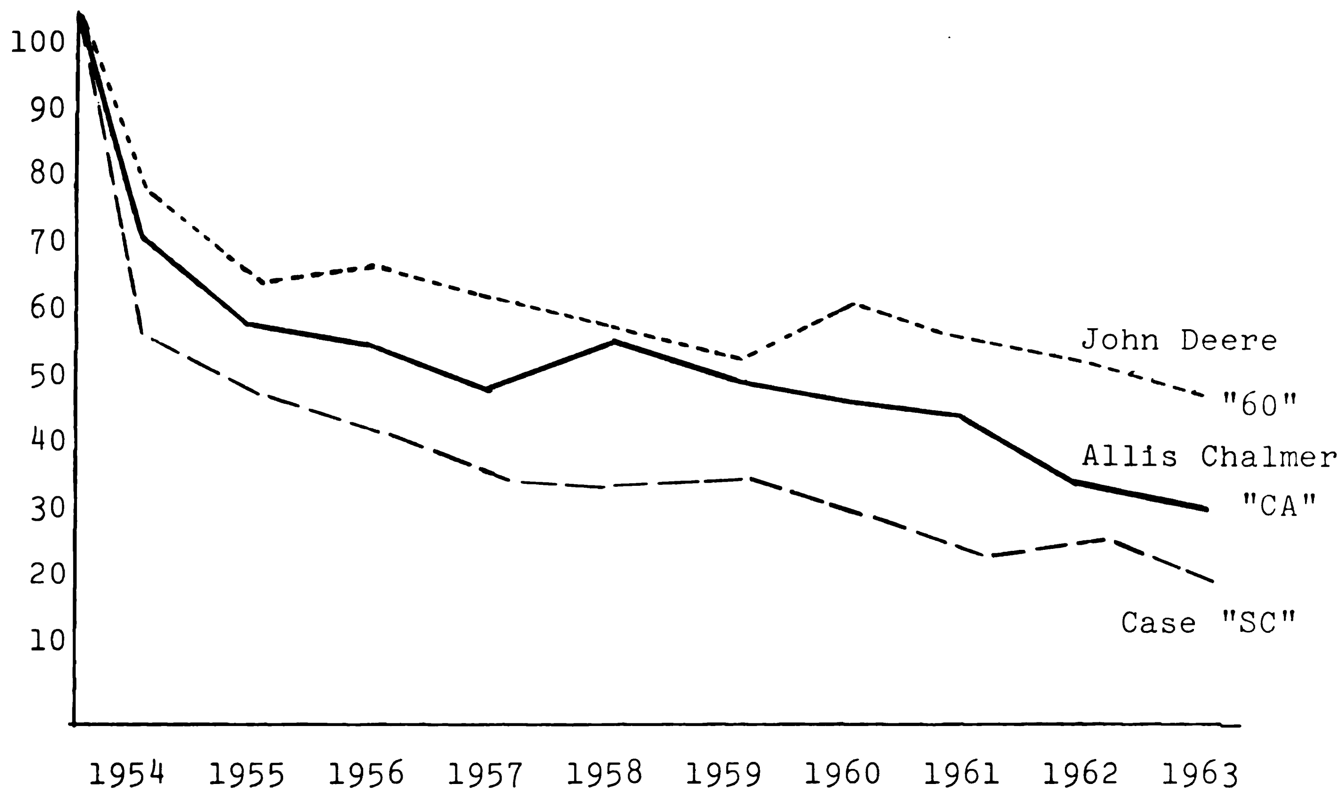

Figure 1---The decline in percentage value (used value/new cost) of selected 1953 model tractors.

Chapter III

ANALYSIS OF USED FARM TRACTOR VALUES

INTRODUCTION

This chapter is concerned with presenting and evaluating selected variables which were expected to have an effect on used tractor values. The tractors chosen for the study were typical farm tractors, as opposed to industrial and track-type tractors, and include models from all the major manufacturers. The data consisted of two samples. One involved tractors manufactured for sale in 1953 and analyzed over the period 1953 to 1963. The other was comprised of 1958 models, examined from 1958 through 1963.

The tractors involved were subdivided into groups of gasoline and diesel powered units. The author hypothesized that they were regarded as somewhat different entities by farmers, and it would therefore be appropriate to examine them separately. Further, the author chose to omit consideration of liquified pertroleum (LPG) units, regarding them as a minor part of the market.

VARIABLES

The variables selected reflect the "demand side" of the used farm machinery market. While demand conditions in the new machinery market (oligopolistic in structure) may not play a very heroic part in new tractor price-setting, it would be unrealistic to discount the role of demand in establishing the value of used farm machinery (a competitive market). The "supply side" of the used farm machinery market was not considered. Estimating the supply of used machines would be a considerable undertaking; and it is doubtful that, given the objectives of this study, such an effort could be justified on the basis of any new knowledge obtained.

The following variables were included in the analysis of used tractor values.

Age

It seems reasonable that age should have an important effect on the value of a used machine, as obsolescence and deterioration are closely associated with it. Farmers and farm machinery dealers undoubtably associate increasing age with decreasing equipment values. This relationship could be formalized in the following way. Farm machinery has a certain useful life (before it becomes so obsolete or so worn out that it is no longer serviceable), and the value of a used machine should reflect the value of services which can still be obtained from it.

The depreciation schedules used for tax purposes embody these concepts, and, in fact, assume implicitly that age is the only variable affecting used values. In this study, age was not expected to be the sole determinant of used values, but it was expected to be a variable of primary importance.

Realized Net Farm Income

Farmers probably do little separating of farm income and family income. The net income realized from the farm, plus limits on the amount of available credit (often self-imposed), then serves as a constraint on the amount of production and consumption goods purchased by the farm family. (Let us disregard the unnecessary complication of supplementary non-farm income.) There is really no problem of noncomparability of production and consumption goods, as investments in production goods may be thought of as deferred consumption. In short, as realized net farm income increases, the budget constraint permits consideration of new consumption possibilities. Expansion of farm income may allow consideration of remodeling the home, learning to play golf, a new hog waterer, an additional tractor or any number of things not possible with the smaller budget constraint. In the usual economic terminology the farm family chooses the combination of consumption goods and deferred consumption, savings and investments in production goods, which maximize their utility. Aggregating consumption plans of farm families, if increased farm income means a greater number of farmers planning to purchase used machinery, it also means a greater demand for used tractors (combines, plows, ----, wagons) and higher used values given fixed supplies.

Realized net farm income was lagged one year, because it was thought that the financial position the farmer found himself in at the years end was most relevant to the following year's machinery investments. It might also be hypothesized that the farmer's expectation for this year's farm income is strongly influenced by last year's net farm income. Thus he might be expected to expand or contract his purchase of productive inputs, including used farm machinery, as a result of his past years experience. The outcome of this situation is consistent with the rationale already hypothesized.

Prices Received by Farmers Index

In recognition of the importance of product price in determining the level of input use, this index was included as a variable. If farmers operate on the basis of marginal adjustments, an increase in the price of a farm product should motivate an increase in the inputs acquired for its production. Since farm machinery is one important input, a change in product prices could change the demand for used machinery and consequently their used values.

This price index is a combination of prices for various groups of commodities weighted by the average quantitites of individual goods sold during 1953 to 1957. It therefore,need not be the same as farm income.

Make

Each of several manufacturers are competing for the farmer's machinery dollar by offering a differentiated product. Although each company has several alternative models, there is a definite similarity within the "make". The hypothesis here is that buyers of used machines attach different values to the various makes. "Make" preferences are undoubtably developed over time on the basis of the farmer's own experience and information obtained from neighbors, dealers, and advertizing.

The make variable differs from those already discussed, because it is qualitative, not quantitative in nature. As a result, it requires a different system of including it in the regression equations. Thus a set of dummy variables is used to represent the makes. (This is also true of the horsepower variable to follow.) Each make is represented by a separate variable. When the observation in question is a given make, say Oliver, a one is entered under the appropriate make variable (Oliver) and all other make variables are assigned a zero. One make must be omitted from the variables to serve as a comparison for the others. In this case it was Minneapolis Moline which, from examining the data, was expected to have the lowest used values. In essence, when a one is entered for a make, the regression equation compares that particular make's used values with those of Minneapolis Moline. This brief explanation of the functioning of dummy variables can be applied to other variables using this system.

Horsepower

The sample of tractors studied encompasses models with widely differing horsepower ratings. It is conceivable that models with certain horsepower ratings could be in greater or lesser demand than others. One might also reason that a given range would include the models with the most popular horsepower ratings. The existence of such a horsepower range would depend upon an associated range of tractor sizes suited to the greatest number of farming operations. The author expected 30 to 40 horsepower and 30 to 50 horsepower to be the most popular ranges for 1953 and 1958 models respectively.

Two dummy variables representing three horsepower ranges were used to test the above proposition. In essence, tractors with less than 30 horsepower and more than either 40 horsepower (1953 models), or 50 horsepower (1958 models), were compared with those included in what was expected to be the most popular horsepower range. (The measure of the individual tractor's horsepower rating was maximum drawbar horsepower given by the Nebraska test dated nearest to the given model year.)

New Models

The new models variable was included to study the effect of the introduction of a new model on the value of the model it replaces. This is a particular type of obsolescence which is unrelated to the age of the machine. To be more specific, does the introduction the Allis Chalmers "D-14" model in 1957 affect how "up-to-date" the farmer regards a 1953 Allis Chalmers "WD-45"? Does the farmer consider the 1953 John Deere "70" now obsolete even though it has many of the same basic technical features of the "3010" John Deere introduced in 1961? This type of obsolescence is not cumulative over time, but occurs suddenly when a new model is introduced to which an older one may be contrasted.

Labor

Machinery can be labor-saving, and thus a substitute for farm labor. As the price of farm labor increases relative to substitutable machinery inputs, marginal analysis suggests that farmers would demand more machinery and less farm labor. Since there is no reason to believe that farmers do not respond to the "better buy" in farm inputs, increasing labor costs could be expected to retard the rate of decrease in used machinery values over time.

Inflation

Inflation could also be expected to partially offset the decline of used farm machinery values. For this study, the Bureau of Labor Statistics wholesale price indices for farm machinery (tractors, balers, combines, forage harvesters, and cornpickers) were used to construct the variable. The logic of this choice of indices rests on a concept of equilibrium between the new and used machinery markets. If new machinery prices rise relative to used machinery prices (a substitute for new machinery), used machinery becomes a "better buy" and prices are bid up in the competitive used equipment market. Consequently a 2% yearly increase in new farm machinery prices should result in a 2% increase in used farm machinery values.

The variable inflation is examined in a somewhat indirect way. The Y_1 values (percentage of original value remaining) were deflated by the appropriate wholesale price index creating a new dependent variable called Y_2. This approach was used because early experience indicated that the indexes, if used directly as a variable, would be highly intercorrelated with the variable age. High intercorrelations between variables makes it difficult for a meaningful analysis of the variable in question.

ESTIMATING EQUATIONS

Age

In order to assess the contribution of age to tractor value determination, four linear, least squares regression equations were computed with age as the only independent variable. Each of the subdivisions of data, 1953 gasoline tractors, 1953 diesel tractors, 1958 gasoline tractors and 1958 diesel tractors are represented by equations given below.

1953 Gasoline Tractors;

Equation #1 $\hat{Y}_1 = \underset{(0.955)}{64.287} - \underset{(0.152)}{3.072}X_1^{**}$

$R^2 = 0.5743$ S.E. = 7.5833

Equation #2 $\hat{Y}_2 = \underset{(0.869)}{65.648} - \underset{(0.139)}{4.100}X_1^{**}$

$R^2 = 0.7436$ S.E. = 6.9027

1953 Diesel Tractors

Equation #3 $\hat{Y}_1 = \underset{(1.260)}{59.367} - \underset{(0.192)}{2.758}X_1^{**}$

$R^2 = 0.6542$ S.E. = 5.7302

Equation #4 $\hat{Y}_2 = \underset{(1.124)}{60.320} - \underset{(0.171)}{3.669}X_1^{**}$

$R^2 = 0.8080$ S.E. = 5.1114

1958 Gasoline Tractors

Equation #5 $\hat{Y}_1 = 74.582 - 4.334X_1^{**}$

$(0.849) \quad (0.250)$

$R^2 = 0.5723$ S.E. = 5.1693

Equation #6 $\hat{Y}_2 = 72.662 - 5.074X_1^{**}$

$(0.788) \quad (0.232)$

$R^2 = 0.6805$ S.E. = 4.7965

1958 Diesel Tractors

Equation #7 $\hat{Y}_1 = 76.100 - 5.398X_1^{**}$

$(0.852) \quad (0.253)$

$R^2 = 0.8193$ S.E. = 3.5636

Equation #8 $\hat{Y}_2 = 74.103 - 6.052X_1^{**}$

$(0.783) \quad (0.233)$

$R^2 = 0.8708$ S.E. = 3.2774

Where: $\hat{Y}_1$ is the estimated value of the machine--in percent of its original cost--based on current dollars. $\hat{Y}_2$ is the estimated value of the machine--in percent of its original cost--based on constant dollars (as adjusted by the Bureau of Labor Statistics wholesale indices). X_1 is the age of the tractor in years. R_2 is the coefficient of multiple determination. S.E. is the standard error of estimate. *indicates the variable was significant at .05 level, and ** indicates significance at .01 level.

Judging from the R^2s given above, age makes a considerable contribution to describing the "loss-in-value" of used farm tractors. ("Loss-in-value" will be used rather than "depreciation" to avoid confusion with depreciation as it is used for income tax purposes.) Also noteworthy is the significance of the variable. In all cases the b value for age was significantly different from zero at the .01 level.

It should be noted that the R^2's and b's for Y_2 equations are larger than their Y_1 counterparts. This is exactly the relationship that should be expected if inflation is important to understanding "loss-in-value". The greater R^2's indicate that the removal of inflation permits age to explain a larger portion of the variation in used values. The larger b's support the proposition that without inflation the "loss-in-value" over time would be more rapid.

Finally, b values for 1958 equations exceed those for comparable 1953 equations, and the diesel equations appear to be somewhat different than their gasoline counterparts. Consideration of the questions raised by these relationships will be deferred until later in the chapter.

Make

The following equations include, along with age, the make of the tractor.

1953 Gasoline Tractors

Equation #9
$$\hat{Y}_1 = \underset{(1.106)}{59.229} - \underset{(0.108)}{3.047}X_1^{**} + \underset{(1.348)}{8.694}X_2^{**} - \underset{(1.234)}{1.513}X_3 + \underset{(1.336)}{3.232}X_4^{*} + \underset{(1.243)}{13.632}X_5^{**} + \underset{(1.925)}{8.742}X_6^{**} + \underset{(1.925)}{18.802}X_7^{**} + \underset{(1.336)}{6.945}X_8^{**} + \underset{(1.243)}{3.157}X_9^{*} + \underset{(1.250)}{1.201}X_{10}$$

$R^2 = 0.7931$ S.E. = 5.3680

Equation #10
$$\hat{Y}_2 = \underset{(1.045)}{61.255} - \underset{(0.102)}{4.078}X_1^{**} + \underset{(1.274)}{7.560}X_2^{**} - \underset{(1.175)}{1.382}X_3 + \underset{(1.263)}{2.619}X_4^{*} + \underset{(1.175)}{11.917}X_5^{**} + \underset{(1.819)}{7.646}X_6^{**} + \underset{(1.819)}{16.411}X_7^{**} + \underset{(1.263)}{6.061}X_8^{**} + \underset{(1.175)}{2.836}X_9^{*} + \underset{(1.181)}{1.023}X_{10}$$

$R^2 = 0.8656$ S.E. = 5.0729

X_1 = Age X_4 = Cockshutt X_7 = Ford

X_2 = Allis Chalmers X_5 = John Deere X_8 = International Harvester

X_3 = Case X_6 = Ferguson X_9 = Massey Harris

X_{10} = Oliver

(Minneapolis Moline is the base for make comparisons)

1953 Diesel Tractors

Equation #11 $\hat{Y}_1 = 57.892 - 2.950X_1^{**} + 1.911X_2 + 10.858X_3^{**}$

$(1.353) \quad (0.153) \quad (1.497) \quad (2.502)$

$+ 10.904X_4^{**} + 1.625X_5 + 0.586X_6$

$(1.582) \quad (1.343) \quad (1.315)$

$R^2 = 0.7981$ S.E. = 4.4827

Equation #12 $\hat{Y}_2 = 58.955 - 3.833X_1^{**} + 1.612X_2 + 9.382X_3^{**}$

$(1.233) \quad (0.140) \quad (1.364) \quad (2.280)$

$+ 9.526X_4^{**} + 1.515X_5 + 0.670X_6$

$(1.441) \quad (1.223) \quad (1.198)$

$R^2 = 0.8830$ S.E. = 4.0850

X_1 = Age X_4 = International Harvester

X_2 = Cockshutt X_5 = Massey Harris

X_3 = John Deere X_6 = Oliver

(Minneapolis Moline is the base for make comparisons)

1958 Gasoline Tractors

Equation #13 $\hat{Y}_1 = 71.217 - 4.588X_1{**} + 1.696X_2 + 10.028X_3{**}$
$\qquad(0.994)\quad(0.196)\quad(1.133)\quad(1.106)$

$+ 5.473X_4{**} + 4.780X_5{**} + 5.736X_6{*} + 6.898X_7{**}$
$\qquad(1.202)\quad(1.085)\quad(2.455)\quad(1.286)$

$+ 4.585X_8{**} + 6.408X_9{**} - 0.832X_{10}$
$\qquad(1.049)\quad(1.202)\quad(1.085)$

$R^2 = 0.7535$ S.E. = 4.0052

Equation #14 $\hat{Y}_2 = 69.529 - 5.306X_1{**} + 1.596X_2 + 9.234X_3{**}$
$\qquad(0.927)\quad(0.183)\quad(1.057)\quad(1.032)$

$+ 5.158X_4{**} + 4.412X_5{**} + 5.227X_6{*} + 6.316X_7{**}$
$\qquad(1.121)\quad(1.057)\quad(2.291)\quad(1.200)$

$+ 4.214X_8{**} + 6.023X_9{**} - 0.732X_{10}$
$\qquad(0.979)\quad(1.121)\quad(1.012)$

$R^2 = 0.8138$ S.E. = 3.7368

X_1 = Age

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = Ferguson

X_7 = Ford

X_8 = International Harvester

X_9 = Massey Harris

X_{10} = Cliver

(Minneapolis Moline is the base for make comparisons)

1958 Diesel Tractors

Equation #15 $\hat{Y}_1 = \underset{(1.294)}{74.720} - \underset{(0.187)}{5.500X_1}^{**} + \underset{(1.429)}{1.470X_2} + \underset{(1.391)}{5.047X_3}^{**}$

$+ \underset{(1.347)}{3.107X_4} + \underset{(1.650)}{5.000X_5}^{**} + \underset{(1.650)}{2.860X_6} + \underset{(1.347)}{1.853X_7}$

$+ \underset{(1.429)}{3.680X_8} - \underset{(1.278)}{2.128X_9}$

$R^2 = 0.9110$ S.E. = 2.6082

Equation #16 $\hat{Y}_2 = \underset{(1.182)}{72.744} - \underset{(0.171)}{6.141X_1}^{**} + \underset{(1.305)}{1.570X_2} + \underset{(1.271)}{4.575X_3}^{**}$

$+ \underset{(1.230)}{2.987X_4} + \underset{(1.506)}{4.720X_5}^{**} + \underset{(1.506)}{2.720X_6} + \underset{(1.230)}{1.900X_7}$

$+ \underset{(1.305)}{3.430X_8}^{*} - \underset{(1.167)}{1.956X_9}$

$R^2 = 0.9372$ S.E. = 2.3820

X_1 = Age

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = Ford

X_7 = International Harvester

X_8 = Massey Harris

X_9 = Oliver

(Minneapolis Moline is the base for make comparisons)

The following list summarizes for both model years the makes which were significantly different from zero, and can generally be thought of as significantly different in value from Minneapolis Moline.

1953 Gasoline

Allis Chalmers**

Cockshutt*

John Deere**

Ferguson**

1953 Diesel

John Deere**

International Harvester**

Ford**

International Harvester**

Massey-Harris**

1958 Gasoline

Case**

Cockshutt**

John Deere**

Ferguson*

International Harvester**

Massey Harris**

Ford**

1958 Diesel

Case**

Cockshutt*

John Deere**

Massey Harris**

(As in the equation * indicates significance at .05 level and ** indicates significance at .01 level.)

Since several of the individual makes were not significant, doubt may exist as to the contribution of the make variables taken as a group. In order to determine if their overall contribution was significant the following F-test was made.

$$F(r-k,n-r-1)=\frac{\dfrac{\text{SSR with make variables}-\text{SSR without make variables}}{r-k}}{\dfrac{SSE\ (n-r-1)}{n-r-1}}$$

Where: n is the number of observations, k is the number of variables for the equation without make variables, r is the number of variables for the equation with make variables.

The contribution of the make variables in aggregate turns out to be significant at .01 level for 1953 gasoline, 1953 diesel, 1958 gasoline, and at the .05 level for 1958 diesel tractors.

Horsepower

With the following set of equations the effect of the selected horsepower ranges was studied in conjunction with age and make. Only the range of 0 to 30 horsepower (30-) and 40 or more horsepower (40+) in 1953, or 50 or more horsepower (50+) in 1958, appear as variables in the equations. The mid-range of horsepower (30-40 or 30-50) serves as a basis of comparison.

1953 Gasoline Tractors

Equation #17 $\hat{Y}_1 = 60.445 - 3.063X_1^{**} + 11.008X_2^{**} - 0.280X_3$
$\qquad (1.158) \quad (0.097) \quad (1.281) \quad (1.141)$

$+ 5.428X_4^{**} + 14.865X_5^{**} + 12.603X_6^{**}$
$\quad (1.270) \quad (1.141) \quad (1.800)$

$+ 22.663X_7^{**} + 7.302X_8^{**} + 3.141X_9^{**}$
$\quad (1.800) \quad (1.214) \quad (1.149)$

$+ 1.230X_{10} - 4.994X_{11}^{**} + 0.524X_{12}$
$\quad (1.159) \quad (0.690) \quad (0.810)$

$R^2 = 0.8342$ S.E. = 4.8212

Equation #18 $\hat{Y}_2 = 62.427 - 4.092X_1^{**} + 9.522X_2^{**} - 0.339X_3$
$\qquad (1.114) \quad (0.093) \quad (1.232) \quad (1.097)$

$+ 4.477X_4^{**} + 12.9605X_5^{**} + 10.982X_6^{**}$
$\quad (1.221) \quad (1.097) \quad (1.731)$

$+ 19.747X_7^{**} + 6.339X_8^{**} + 2.771X_9^{**}$
$\quad (1.731) \quad (1.167) \quad (1.105)$

$+ 0.993X_{10} - 4.434X_{11}^{**} + 0.304X_{12}$
$\quad (1.114) \quad (0.663) \quad (0.779)$

$R^2 = 0.8885$ S.E. = 4.6367

X_1 = age	X_5 = John Deere	X_9 = Massey Harris
X_2 = Allis Chalmers	X_6 = Ferguson	X_{10} = Oliver
X_3 = Case	X_7 = Ford	X_{11} = 30-h.p.
X_4 = Cockshutt	X_8 = International Harvester	X_{12} = 40+h.p.

(Minneapolis Moline is the base for make comparison, 30-40 h.p. is the base for horsepower comparisons.)

1953 Diesel Tractors

Equation #19 $\hat{Y}_1 = 57.931 - 2.928X_1^{**} + 3.629X_2 + 10.797X_3^{**}$
$\quad (2.371) \quad (0.147) \quad (2.428) \quad (2.386)$

$+ 10.891X_4^{**} + 1.578X_5 + 1.954X_6 - 4.586X_7^{**}$
$\quad (1.508) \quad (1.370) \quad (2.315) \quad (1.303)$

$- 0.166X_8$
$\quad (1.890)$

$R^2 = 0.8200$ S.E. = 4.2742

Equation #20 $\hat{Y}_2 = 58.447 - 3.809X_1^{**} + 3.683X_2 + 9.314X_3^{**}$
$\quad (2.163) \quad (0.134) \quad (2.215) \quad (2.177)$

$+ 9.511X_4^{**} + 1.606X_5 + 2.421X_6 - 4.135X_7^{**}$
$\quad (1.376) \quad (1.250) \quad (2.112) \quad (1.189)$

$+ 0.367X_8$
$\quad (1.724)$

$R^2 = 0.8796$ S.E. = 4.1900

X_1 = age
X_2 = Cockshutt
X_3 = John Deere
X_4 = International Harvester
X_5 = Massey Harris
X_6 = Oliver
X_7 = 30-h.p.
X_8 = 40+h.p.

(Minneapolis Moline is the base for comparison of makes, 30-40 h.p. is the base for horsepower comparison)

1958 Gasoline Tractors

Equation #21

$$\hat{Y}_1 = \underset{(0.973)}{71.119} - \underset{(0.190)}{4.574X_1^{**}} + \underset{(1.129)}{2.821X_2^{**}} + \underset{(1.090)}{10.840X_3^{**}}$$
$$+ \underset{(1.177)}{6.127X_4^{**}} + \underset{(1.119)}{5.376X_5^{**}} + \underset{(2.377)}{5.778X_6^{*}}$$
$$+ \underset{(1.252)}{6.947X_7^{**}} + \underset{(1.056)}{5.284X_8^{**}} + \underset{(1.162)}{6.394X_9^{**}}$$
$$+ \underset{(1.072)}{0.067X_{10}} - \underset{(0.696)}{2.671X_{11}^{**}} + \underset{(0.740)}{0.280X_{12}}$$

$R^2 = 0.7718$ S.E. = 3.8713

Equation #22

$$\hat{Y}_2 = \underset{(0.909)}{69.452} - \underset{(0.177)}{5.293X_1^{**}} + \underset{(1.054)}{2.627X_2^{**}} + \underset{(1.018)}{9.975X_3^{**}}$$
$$+ \underset{(1.099)}{5.769X_4^{**}} + \underset{(1.045)}{4.977X_5^{**}} + \underset{(2.220)}{5.253X_6^{*}}$$
$$+ \underset{(1.169)}{6.348X_7^{**}} + \underset{(0.987)}{4.879X_8^{**}} + \underset{(1.085)}{6.013X_9^{**}}$$
$$+ \underset{(1.002)}{0.101X_{10}} - \underset{(0.650)}{2.482X_{11}^{**}} + \underset{(0.691)}{0.193X_{12}}$$

$R^2 = 0.8273$ S.E.= 3.6157

X_1 = age
X_2 = Allis Chalmers
X_3 = Case
X_4 = Cockshutt
X_5 = John Deere
X_6 = Ferguson
X_7 = Ford
X_8 = International Harvester
X_9 = Massey Harris
X_{10} = Oliver
X_{11} = 30-h.p.
X_{12} = 50+h.p.

(Minneapolis Moline is the base for comparison of makes, 30-50 h.p. is the base for horsepower comparisons)

1958 Diesel Tractors

Equation #23

$$\hat{Y}_1 = \underset{(1.478)}{73.978} - \underset{(0.185)}{5.500X_1^{**}} + \underset{(1.595)}{2.212X_2} + \underset{(1.461)}{5.969X_3^{**}}$$

$$+ \underset{(1.420)}{3.602X_4^{**}} + \underset{(1.630)}{5.000X_5^{**}} + \underset{(1.791)}{3.602X_6^{*}} + \underset{(1.420)}{2.348X_7}$$

$$+ \underset{(1.595)}{4.422X_8^{**}} - \underset{(1.395)}{1.021X_9} - \underset{(0.921)}{1.282X_{10}} + \underset{(0.742)}{0.742X_{11}}$$

$R^2 = 0.9149$ S.E. = 2.5775

Equation #24

$$\hat{Y}_2 = \underset{(1.347)}{71.934} - \underset{(0.168)}{6.141X_1^{**}} + \underset{(1.453)}{2.380X_2} + \underset{(1.331}{5.490X_3^{**}}$$

$$+ \underset{(1.294)}{3.527X_4^{**}} + \underset{(1.485)}{4.720X_5^{**}} + \underset{(1.632)}{3.530X_6^{*}} + \underset{(1.294)}{2.440X_7}$$

$$+ \underset{(1.453)}{4.240X_8^{**}} - \underset{(1.271)}{0.858X_9} - \underset{(0.839)}{1.124X_{10}} + \underset{(0.676)}{0.810X_{11}}$$

$R^2 = 0.9403$ S.E. = 2.3481

X_1 = age
X_2 = Allis Chalmers
X_3 = Case
X_4 = Cockshutt
X_5 = John Deere
X_6 = Ford
X_7 = International Harvester
X_8 = Massey Harris
X_9 = Oliver
X_{10} = 30-h.p.
X_{11} = 50+h.p.

(Minneapolis Moline is the base for comparison of makes, 30-50 h.p. is the base for horsepower comparisons)

The upper range of horsepower (40 + h.p.---1953 and 50+ h.p. --- 1958) was not significantly different from zero in its effect on any of the models. The lower range (30-h.p.), however, had a significant effect on 1953 gasoline, 1953 diesels, and 1958 gasoline tractors, but not 1958 diesel units. Using an F-test equivalent to the one applied to makes, the combination of horsepower variables was found to be significant at the .01 level for 1953 gasoline, 1953 diesel, 1958 gasoline tractors; and at the .10 level for 1958 diesel tractors.

All of the make variables which were significantly different from the base make at the .05 level before horsepower was included, were again significant with its inclusion. In addition, Allis Chalmers became significantly different from zero (.01)for 1958 gasoline tractors and Ford for 1958 diesel tractors (.05). Although the b values are different, as would be expected, for the Y=f (Age,Make, H.P.) and Y=f (Age,Make) equations, the relationships between the individual makes appear to be consistent.

Curvilinear Function

Analysis of the linear equations and their residuals indicated that a function which was curvilinear for age might more nearly fit the data. The following equations constitute an attempt to fit this type of curvilinear equation to the samples. These equations differ from the ones reported in the previous section only with respect to age, which here consists of two variables X_1 and X_1^2. Thus, the equations in this section are of the form:

$$Y = a + b_1X_1 + b_{1-a}X_1^2 + b_2X_2 + \text{----} + bnXn$$

1953 Gasoline Tractors

Equation #25 $$\hat{Y}_1 = \underset{(1.362)}{65.293} - \underset{(0.411)}{5.426X_1^{**}} + \underset{(0.036)}{0.217X_1^{2**}} + \underset{(1.211)}{11.123X_2^{**}}$$

$$- \underset{(1.078)}{0.270X_3} + \underset{(1.200)}{5.450X_4^{**}} + \underset{(1.078)}{14.875X_5^{**}}$$

$$+ \underset{(1.701)}{12.636X_6^{**}} + \underset{(1.701)}{22.696X_7^{**}} + \underset{(1.147)}{7.305X_8^{**}}$$

$$+ \underset{(1.086)}{3.144X_9^{**}} + \underset{(1.095)}{1.301X_{10}} - \underset{(0.652)}{5.023X_{11}^{**}} + \underset{(0.766)}{0.551X_{12}}$$

$R^2 = 0.8525$ S.E. = 4.5558

Equation #26 $$\hat{Y}_2 = \underset{(1.137)}{70.489} - \underset{(0.344)}{8.082X_1^{**}} + \underset{(0.030)}{0.361X_1^{2**}} + \underset{(1.011)}{9.713X_2^{**}}$$

$$- \underset{(0.890)}{0.322X_3} + \underset{(1.002)}{4.514X_4^{**}} + \underset{(0.890)}{12.976X_5^{**}}$$

$$+ \underset{(1.420)}{11.036X_6^{**}} + \underset{(1.420)}{19.802X_7^{**}} + \underset{(0.957)}{6.344X_8^{**}}$$

$$+ \underset{(0.907)}{2.775X_9^{**}} + \underset{(0.914)}{1.112X_{10}} - \underset{(0.544)}{4.486X_{11}^{**}} + \underset{(0.639)}{0.349X_{12}}$$

$R^2 = 0.9252$ S.E. = 3.8035

X_1 = age	X_5 = John Deere	X_9 = Massey Harris
X_2 = Allis Chalmers	X_6 = Ferguson	X_{10} = Oliver
X_3 = Case	X_7 = Ford	X_{11} = 30-h.p.
X_4 = Cockshutt	X_8 = International Harvester	X_{12} = 40+h.p.

(Minneapolis Moline is the base for make comparisons, 30-40 h.p. is the base for horsepower comparisons)

1953 Diesel Tractors

Equation #27 $\hat{Y}_1 = 58.297 - 3.083X_1{**} + 0.014X_1^2 + 3.585X_2$
$\qquad (2.816) \quad (0.655) \qquad (0.057) \quad (2.445)$
$\quad + 10.770X_3{**} + 10.876X_4{**} + 1.569X_5$
$\qquad (2.400) \qquad (1.516) \qquad (1.377)$
$\quad + 1.912X_6 - 4.587X_7{**} - 0.199X_8$
$\qquad (2.332) \quad (1.309) \qquad (1.904)$

$R^2 = 0.8201$ S.E. = 4.2940

Equation #28 $\hat{Y}_2 = 62.924 - 5.712X_1{**} + 0.169X_1^2{**} + 3.150X_2$
$\qquad (2.430) \quad (0.566) \qquad (0.048) \qquad (2.110)$
$\quad + 8.988X_3{**} + 9.334X_4{**} + 1.489X_5 + 1.907X_6$
$\qquad (2.071) \qquad (1.309) \qquad (1.188) \quad (2.013)$
$\quad - 4.154X_7{**} - 0.036X_8$
$\qquad (1.130) \qquad (1.643)$

$R^2 = 0.9065$ S.E. = 3.7059

X_1 = Age X_5 = Massey Harris
X_2 = Cockshutt X_6 = Oliver
X_3 = John Deere X_7 = 30-h.p.
X_4 = International Harvester X_8 = 40+h.p.

(Minneapolis Moline is the base for make comparisons, 30-40 h.p. is the base for horsepower comparisons.)

1958 Gasoline Tractors

Equation #29
$$\hat{Y}_1 = \underset{(1.483)}{75.088} - \underset{(0.962)}{7.862X_1^{**}} + \underset{(0.154)}{0.535X_1^{2\,**}} + \underset{(1.101)}{2.834X_2^{**}}$$
$$+ \underset{(1.066)}{11.156X_3^{**}} + \underset{(1.147)}{6.131X_4^{**}} + \underset{(1.091)}{5.377X_5^{**}}$$
$$+ \underset{(2.319)}{6.037X_6^{**}} + \underset{(1.224)}{7.258X_7^{**}} + \underset{(1.030)}{5.285X_8^{**}}$$
$$+ \underset{(1.133)}{6.393X_9^{**}} + \underset{(1.046)}{0.075X_{10}} - \underset{(0.679)}{2.692X_{11}^{**}} + \underset{(0.721)}{0.305X_{12}}$$

$R^2 = 0.7841$ S.E. = 3.7744

Equation #30
$$\hat{Y}_2 = \underset{(1.368)}{73.863} - \underset{(0.888)}{8.947X_1^{**}} + \underset{(0.142)}{0.595X_1^{2\,**}} + \underset{(1.016)}{2.642X_2^{**}}$$
$$+ \underset{(0.984)}{10.326X_3^{**}} + \underset{(1.059)}{5.773X_4^{**}} + \underset{(1.007)}{4.978X_5^{**}}$$
$$+ \underset{(2.140)}{5.541X_6^{**}} + \underset{(1.129)}{6.693X_7^{**}} + \underset{(0.950)}{4.879X_8^{**}}$$
$$+ \underset{(1.045)}{6.012X_9^{**}} + \underset{(0.965)}{0.110X_{10}} - \underset{(0.627)}{2.505X_{11}^{**}} + \underset{(0.665)}{0.220X_{12}}$$

$R^2 = 0.8405$ S.E. = 3.4832

X_1 = age	X_5 = John Deere	X_9 = Massey Harris
X_2 = Allis Chalmers	X_6 = Ferguson	X_{10} = Oliver
X_3 = Case	X_7 = Ford	X_{11} = 30-h.p.
X_4 = Cockshut	X_8 = International Harvester	X_{12} = 50+h.p.

(Minneapolis Moline is the base for comparison of makes, 30-50 h.p. is the base for horsepower comparisons.)

1958 Diesel Tractors

$$\text{Equation \#31} \quad \hat{Y}_1 = \underset{(1.864)}{73.946} - \underset{(0.963)}{5.474X_1^{**}} - \underset{(0.155)}{0.004X_1^2} + \underset{(1.604)}{2.212X_2}$$

$$+ \underset{(1.472)}{5.967X_3^{**}} + \underset{(1.428)}{3.602X_4^{**}} + \underset{(1.639)}{5.000X_5^{**}}$$

$$+ \underset{(1.801)}{3.602X_6^{*}} + \underset{(1.428)}{2.348X_7} + \underset{(1.604)}{4.422X_8^{**}} - \underset{(1.403)}{1.021X_9}$$

$$- \underset{(0.926)}{1.282X_{10}} + \underset{(0.747)}{0.742X_{11}}$$

$R^2 = 0.9149$ S.E. = 2.5919

$$\text{Equation \#32} \quad \hat{Y}_2 = \underset{(1.689)}{72.930} - \underset{(0.873)}{6.978X_1^{**}} + \underset{(0.141)}{0.138X_1^2} + \underset{(1.453)}{2.380X_2}$$

$$+ \underset{(1.334)}{5.564X_3^{**}} + \underset{(1.394)}{3.527X_4^{**}} + \underset{(1.485)}{4.720X_5^{**}}$$

$$+ \underset{(1.632)}{3.530X_6^{*}} + \underset{(1.294)}{2.440X_7} + \underset{(1.453)}{4.240X_8^{**}} - \underset{(1.272)}{0.858X_9}$$

$$- \underset{(0.839)}{1.124X_{10}} + \underset{(0.677)}{0.810X_{11}}$$

$R^2 = 0.9409$ S.E. = 2.3487

X_1 = Age	X_4 = Cockshutt	X_7 = International Harvester
X_2 = Allis Chalmers	X_5 = John Deere	X_8 = Massey Harris
X_3 = Case	X_6 = Ford	X_9 = Oliver
X_{10} = 30-h.p.	X_{11} = 50+h.p.	

(Minneapolis Moline is the base for comparison of makes, 30-50 h.p. is the base for horsepower comparisons.)

The b values for the variable <u>age squared</u> were significantly different from zero for 1953 gasoline Y_1 and Y_2 equations, 1958 gasoline Y_1 and Y_2 equations, and the 1953 diesel Y_2 equation. It was not significant, however, for the 1953 diesel Y_1 equation, or 1958 diesel Y_1 and Y_2 equations. In general, the squared term was quite helpful in explaining "loss-in-value" for the gasoline tractors, but not very useful when applied to the diesel units. (This observation will be examined later in the chapter.)

In no instance did the addition of the <u>age squared</u> variable significantly change the b values for <u>make</u> and <u>horsepower</u> from those given by the simpler equation, Y = f (Age, Make, Horsepower)

INTERPRETATION

<u>Analysis of the Equations</u>

To obtain the maximum amount of information from the regression equations, it is necessary to go beyond examining individual equations. The analysis to follow is the product of comparisons of equations, and certain statistical tests.

<u>Age</u>

<u>Age</u> is a highly significant and important variable. The significance level for the variable indicates that there is less than one chance in a thousand that age could have had no effect on the value of used farm tractors. More importantly,

age seems to be capable of explaining from 57 percent to 87 percent of the variation in used value for the tractors sampled. In addition, the b values for the age variable are very consistent throughout the linear equations. The table below lists the b values for age with each model and equation.

TABLE 8---Summary of the b values for the age variable from equations 1 through 24.

MODEL	Y=f (Age)	Y=f (Age,Make)	Y=f (Age,Make,H.P)
1953 Gasoline--Y_1	-3.072	-3.047	-3.063
1953 Gasoline--Y_2	-4.100	-4.078	-4.092
1953 Diesel--Y_1	-2.684	-2.881	-2.858
1953 Diesel--Y_2	-3.669	-3.779	-3.753
1958 Gasoline--Y_1	-4.334	-4.588	-4.574
1958 Gasoline--Y_2	-5.074	-5.306	-5.293
1958 Diesel--Y_1	-5.398	-5.500	-5.500
1958 Diesel--Y_2	-6.052	-6.141	-6.141

There are no significant differences between the b values for the various equations of each model and dependent variable formulation. This means that make and horsepower are complementary to age, rather than substitutes for it.

The author's contention that diesel and gasoline tractors should be studied separately can be examined using the simple Y = f (Age) equations. It is a minor task to show that the equations for 1958 diesel and gasoline tractors are significantly different. Using the first step of covariance analysis, the slopes of the equations were found to be significantly different at the .005 level.[17/]

A statistical argument for separating 1953 diesel and gasoline models will not be attempted. The first step of covariance analysis failed to indicate a significant difference between the b values of their respective equations. And to test the significance of the difference between the constant terms would involve computation of a combined regression equation.

The calculation of separate equations did, however, bring out an interesting point that would have otherwise gone unnoticed. Comparison of these equations seems to indicate an increasing acceptance of used diesel tractors.

[17/] See George Snedecor, Statistical Methods. (Iowa State College Press, Ames, Iowa, 1956), pp. 394-398 for details on this method.

TABLE 9---Estimates of the percentage value(used value/ new cost) for 1953 diesel and gasoline tractors computed from equations 1 through 4.

	Years of Age									
MODEL	1	2	3	4	5	6	7	8	9	10
				(Percent)						
1953-D-Y_1	56.4	53.7	51.0	48.3	45.7	43.0	40.3	37.6	34.9	32.2
1953-G-Y_1	61.2	58.1	55.1	52.0	48.9	45.9	42.8	39.7	36.6	33.6
1953-D-Y_2	56.7	53.0	49.3	45.6	42.0	38.3	34.6	31.0	27.3	23.6
1953-G-Y_2	61.5	57.4	53.3	49.2	45.1	41.0	36.9	32.8	28.7	24.6

Y_1 represents percentage value based on current dollars, Y_2 is percentage value based on constant dollars.

Note that the magnitude of the differences between 1953 gasoline and diesel tractor values, as estimated by Y=f (Age), lessens as the tractors grow older. Based on this observation, it could be hypothesized that farmer's attitudes toward used diesel tractors changed over the decade, 1953 to 1963. This would be consistent with the increasing number of diesels among farm tractors, as reported by the U.S.D.A.[18/] A comparison of first year values (as estimated by equations #1,3,5, and 7) for 1953 and 1958 diesel and gasoline tractors gives some support to the hypothesis.

[18/] Diesel and LPG tractors were about one-half of tractor population in 1963, as opposed to 5 percent in 1952. LPG numbers have remained almost unchanged since 1958. U.S. Department of Agriculture, Farm Cost Situation,FC-35, November 1963, P. 14.

TABLE 10.---Percentage values (used value/new cost) for one year old gasoline and diesel tractors, 1953 and 1958 models, as estimated by equations # 1,3,5, and 7.

Model Year	Gasoline	Diesel
1953	61.2 percent	56.4 percent
1958	70.3 percent	70.7 percent

In 1954, the one year old diesel tractor was not as well received as the gasoline models. By 1959 the one year old diesel tractor seems to be as well accepted as its gasoline counterpart. This is probably due to farmers' increased experience with diesel tractors during the period studied.

At this point the discussion is directed toward explaining the differences in constant terms and b values for comparable 1953 and 1958 equations. At first glance it would appear that 1958 models had a smaller initial drop in value than 1953 models (approximately 30 percent and 40 percent respectively) and a more rapid rate of decline thereafter (4.3 percent as opposed to 3.0 percent for gasoline models.) A closer examination reveals that the difference is probably due to curvilinearity, rather than any important difference in data.

The average of the residuals (actual value minus the value estimated by the regression equation) for each year of age was computed for several equations. This was done by grouping all the residuals associated with a given year of age (1,2,3,---, 10), and taking the arithmetic average of each group. In general, these residuals vary from the regression line in a systematic manner. Table 11 below illustrates the pattern of variations.

TABLE 11.---Average yearly residuals (actual value-estimated value) from the regression equations, Y_1 = f (Age), for 1953 and 1958 gasoline and diesel tractors.

	Years of Age									
Equation	1	2	3	4	5	6	7	8	9	10
	Percentage Points									
#1--1953 Gasoline	5.69	-1.15	-1.41	-3.18	-3.09	0.29	1.18	0.21	0.74	1.11
#3--1953 Diesel	2.25	0.48	-0.87	-2.94	-3.23	2.20	1.10	2.19	-0.15	-1.23
#5--1958 Gasoline	0.57	0.37	-0.77	-1.07	1.10					
#7--1958 Diesel	-0.07	-0.10	0.14	0.27	-0.25					

In examining Table 11, it is necessary to keep in mind that a positive residual is an underestimation, while a negative residual represents an overestimation of the actual value by the equation. Thus the general pattern of the residuals given in the table is one of underestimating the average values in the early part of the equation, overestimation for the midrange of years, and underestimation again in the later years. (1958 diesel is a exception, but one should note the size of the residuals and remember the high R^2 for this equation.---0.8193). This pattern of variation from the linear model may be clearer if it is presented in graphical form, as in figures 2 and 3.

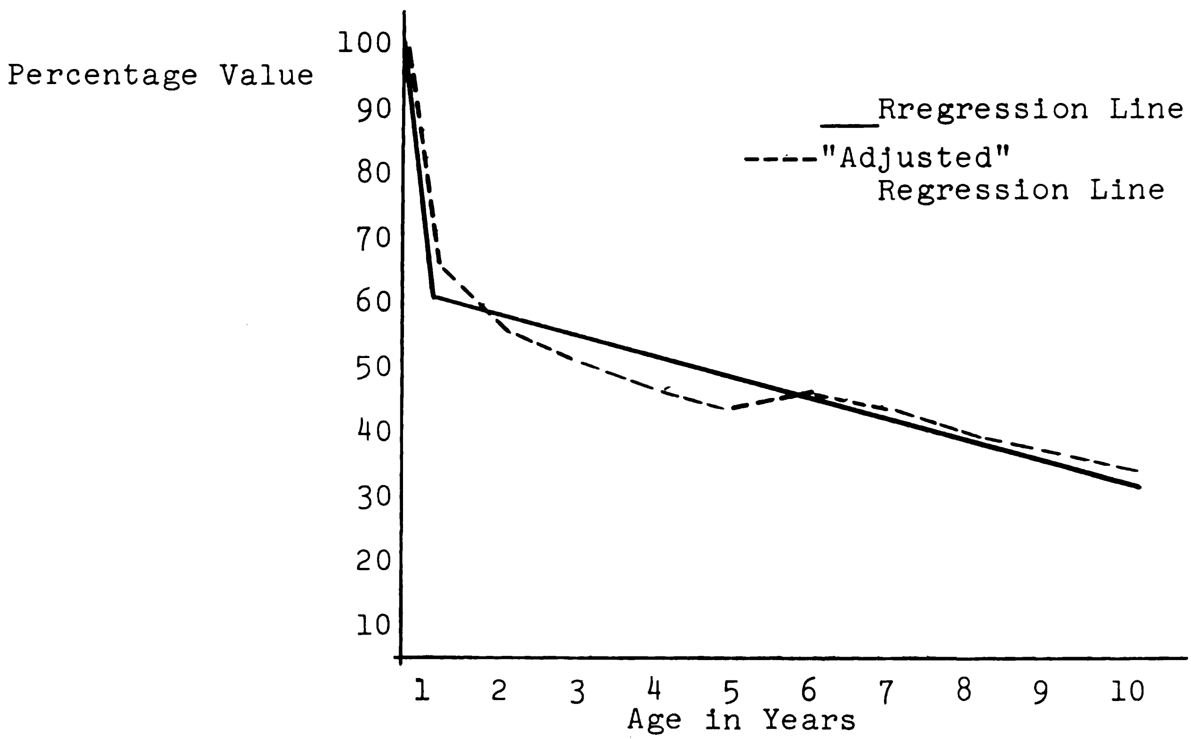

Figure 2.---Linear regression line for 1953 gasoline tractors (equation #1) and regression line "adjusted" by adding the average residual for each year.

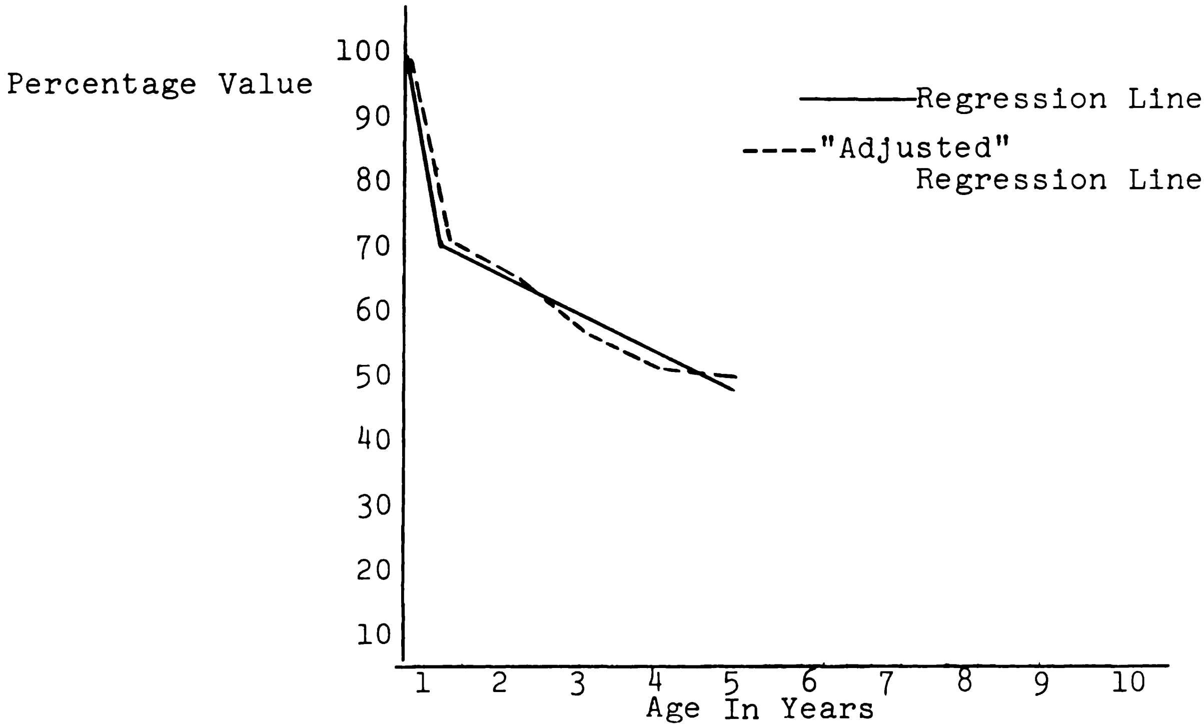

Figure 3.---Linear regression line for 1958 gasoline tractors (equation #5) and regression line "adjusted" by adding the average residual for each year.

If one visually smooths out the "adjusted" curves given in the above graphs, it would appear that "loss-in-value" is a curvilinear function whose slope declines over time. Therefore the greater b values should be for 1958 linear equations which measure the steepest portion of the function. By the same reasoning, the 1953 linear equations would have less slope in order to provide the best "fit" for the longer period. As a result of this smaller slope, 1953 equations underestimate the first year's used value.

There is no reason to believe that the addition of any of the other variables, except <u>age squared</u>, would alter this pattern of curvilinearity.

<u>Realized Net Farm Income</u>

<u>Realized net farm</u> income as a variable was expected to be a partial explanation of the discontinuities of decline in used tractor values. (See Chapter 2, Table 6 for a rather impressive illustration of this situation.) Including this variable produced very promising results with 1953 gasoline tractors. It was significant in all the equations at .005 level. The b values ranged from 1.436 to 1.597; which meant that for every billion dollar increase in realized net farm income, the percentage value of used tractors increased by about 1.5%. However, since the farm income variation did not exceed three billion dollars over the 1953-1963 period, the greatest possible variation in used tractor values attributable to changes in farm income was 4.5%.

Difficulties appeared when the variable was included in the other tractor equations. Its effect was not significantly different from zero for 1953 diesel, 1958 gasoline, and 1958 diesel equations. Further, it took on a negative sign with 1958 diesel tractors which is inconsistent with the rationale for its inclusion. Due to these problems and the relatively small contribution made by the <u>realized net farm income</u>

variable, it was omitted from the final equations.

Prices Received Index

Prices received index was not significant as a variable with 1958 diesel tractors. It was significant for 1958 gasoline tractors, but the b value was negative. This infers that as farm product prices rise, the demand for farm tractors decreases. According to the rationale for this variable, such a response would be unrealistic. The variable was also highly intercorrelated with both age and realized net farm income. In view of these problems, it was not included in 1953 equations.

Make

The purpose of this section is to go beyond simply listing makes with significant b values, toward unraveling the complicated relationships between makes and developing some generalizations about their effect.

The following is a summary of what seems to be the relationships between makes; (1) FORD was particularly important among the 1953 gasoline models. According to equation #9 it was valued significantly higher than all other makes. This may be somewhat of a surprise since Ford manufactured only one model in 1953, a relatively small, low slung, compact standard model. This however, was probably the reason for its popularity. The 1953 Ford seemed to be well adapted to mechanical loaders and other mounted equipment (backhoes, blades, cement mixers,) and consequently was in demand for light industrial work. These same features, coupled with its small size and maneuverability, without doubt made the 1953 Ford particularly attractive for small, part-time farm operations and as a second tractor. The relative valuation of Ford in 1958 seems to support these conclusions. (See equation #13). Ford tractors for that year came in four models; two were standard models comparable to the "NAA" (1953 Ford). The other two models were tricycle-type with a higher ground clearance. Observation of the data indicates that 1958 standard Ford tractors assumed higher valuations than the tricycle models. Ford's tricycle design, more typical of contemporary farm tractors of other makes, evidently did not possess the characteristics desired by the purchasers of their small standard models.

It is incorrect to say that this aggregate of 1958 gasoline Ford tractors caused the Ford variable to decline relative to other makes but it most assuredly did lose the dominant position it had enjoyed among 1953 models.

The 1958 Ford diesel is quite another matter. It was an import from Great Britian and could almost be considered another make. This model was significantly different from only Oliver. Therefore, it is difficult to assign it any relative position.

(2) CASE in 1953 was valued at significantly less than all makes, except Oliver and Minneapolis Moline. In 1958 its position was nearly reversed. For gasoline tractors of that year, Case was valued significantly higher than all makes excepting Ferguson. For 1958 diesel tractors, where there is very little difference between most of the makes, it was significantly different from International Harvester, Allis Chalmers, Oliver, and Minneapolis Moline. It is the author's observation that the 1958 Case tractors differed markedly in outward appearance from the 1953 models. This, perhaps, contributed to the large change in the value of Case relative to other makes.

(3) John Deere was exceeded only by the leading used makes for their respective model years, (Ford was valued significantly higher for 1953 and Case for 1958 models). However, John Deere did not seem to be quite as valuable relative to other makes in the 1958 equations as it was in the 1953 equations. For example, with 1953 gasoline tractors, John Deere was valued significantly higher than Allis Chalmers, Ferguson, International Harvester, Massey Harris, Cockshutt, Oliver, Case and Minneapolis Moline. Among 1958 models it was valued significantly higher than Allis Chalmers, Oliver, and Minneapolis Moline.

(4) MINNEAPOLIS MOLINE AND OLIVER clearly were the lowest valued makes for the equations as a whole. Oliver was never

significantly different from Minneapolis Moline, and every other make, was in one equation or another, valued significantly higher than both of them.

(5) ALLIS CHALMERS was valued higher than Cockshutt, Case, Massey Harris, Oliver and Minneapolis Moline as a 1953 gasoline model. But with 1958 models (both gasoline and diesel) Allis Chalmers was not even significantly different from Oliver and Minneapolis Moline. This seems to indicate a decline in relative position of Allis Chalmers as a make. There also seems to be a relatively good explanation for this decline. It has to do with the manufacturer's curious practice of introducing new models to part of the line and offering them for sale concurrently with older models, (even those replaced by new models.) Here is how it worked with Allis Chalmers in 1958. Allis Chalmers offered models "B", "CA", "D-14", "WD-45", and "D-17" in 1958. The "D-14" and "D-17" were rather radically different from the "B", "CA" and "WD-45" which were first offered in or before 1953. In 1959 Allis Chalmers offered the "D-10" and "D-12" similar in design to the "D-14" and "D-17" as replacements for the "B" and "CA". The full complement of new models and complete phasing out of the older models did not occur until 1960. Thus in 1958 the "obsolete" was sold concurrently with the "modern" models. The table below contrasts the valuation of the two groups of models.

TABLE 12---Percentage values (used values/new cost) of selected 1958 Allis Chalmers gasoline tractors---"B", "CA", "WD-45" models introduced in 1953 (obsolete) and "D-17", "D-14" models introduced in 1958 (modern)---over the period 1958 to 1963.

Model	Percentage Values in Years				
	1959	1960	1961	1962	1963
		(OBSOLETE)			
AC "B"	66.6	59.2	53.2	41.7	36.3
AC "CA"	65.5	60.4	53.3	45.5	40.8
AC "WD-45"	67.9	68.1	59.9	60.1	55.2
(Average)	66.6	62.8	55.4	49.1	40.7
		(MODERN)			
AC "D-14"	69.5	67.8	64.7	61.0	57.1
AC "D-17"	68.6	65.4	65.6	64.8	60.5
(Average)	69.1	66.6	65.1	62.9	58.8

The disparity between the data for the "obsolete" and "modern" models is clearly discernable. A sizeable constrast remains even after adding 4%--- to adjust for less than thirty horsepower---to the "CA" and "B" models.

TABLE 13---Average values of 1958 Allis Chalmers "B", "CA" and "WD-45" ("obsolete")---with "CA" and "B" adjusted to compensate for lower value due to smaller horsepower---contrasted with 1958 Allis Chalmers "D-17" and "D-14" ("modern") models.

	(Percentages Value In Year)				
Models	1959	1960	1961	1962	1963
"Obsolete" (Average)	69.1	65.8	58.1	55.1	46.8
"Modern" (Average)	69.1	66.6	65.1	62.9	58.8

In short, the "obsolete" models, which make up more than half of the 1958 Allis Chalmers line, were not competitive in the used tractor market with the more "modern" models of other makes. Therefore, the aggregate value of Allis Chalmers declined relative to other makes.

(6) <u>FERGUSON AND INTERNATIONAL HARVESTER</u> were not significantly different in value as <u>makes</u> of gasoline tractors, (Ferguson did not build a diesel model in either year) despite their great technical dissimilarities. Both were valued significantly below Ford and John Deere in the 1953 equations and Ford and Case in the 1958 equations. They were valued significantly higher than Cockshutt, Case, Oliver, and Minneapolis Moline in 1953. In no case were they significantly different from Allis Chalmers.

(7) COCKSHUTT AND MASSEY HARRIS are in exactly the same position with respect to other makes. Both makes were valued significantly lower as 1953 models than Ford, John Deere, Allis Chalmers, Ferguson and International Harvester. In 1958 they were not significantly different from these same makes, except for Allis Chalmers which they exceeded in value.

By way of generalizations, the following seem applicable to findings. (1) Although make is a very useful variable in explaining used farm tractor values, it is probably not very helpful in predicting them. Allis Chalmers and Case are examples of the difficulties that might arise in predicting the relative values of makes in the future. Another problem is to determine the amount of value to assign each make. (2) Related to this last problem is the likelihood that the difference in value between makes is also a function of time. It seems altogether reasonable that farmers are continuously reassessing the various makes and changing their relative evaluations. This could be regarded as "proving" the model over time. The fact that a greater number of models are significantly different from one another in the 1953 than in the 1958 equation seems to support this assertion.

The standard errors of the estimated tractor values for each year, calculated from the residuals, also seem to point to this conclusion.

TABLE 14---Standard error of the regression estimates of 1953 gasoline tractor values for each year, 1954-1963, calculated from the residuals of equations #1 and #9.

	Standard of Estimates for Year									
Equation	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
	(Percentage Points)									
(1) Equation # 1---Y_1^2=f (Age)	7.75	4.91	6.37	6.77	7.84	5.50	7.76	8.87	9.19	8.89
(2) Equation # 9---Y_1=f (Age,Make)	7.42	3.95	4.48	5.23	5.10	4.10	4.75	5.70	6.14	5.94
(2) / (1)	95.7%	86.4%	70.3%	77.2%	65.0%	74.5%	61.2%	64.2%	66.8%	66.8%

$$S.E. = \frac{\Sigma\ (Y_i - \hat{Y}_j)^2}{n-1}$$

Where: i is all actual values for a given year, j is the appropriate estimated value within a given year, n is the number of observations for a given year.

Note that the standard errors for Y = f (Age, Make) tend to be smaller, relative to Y = f (age), for the later years of the time span.

One further bit of evidence is a graphical comparison of the used values of two tractor models whose make variables were significantly different---1953 John Deere "60" and 1953 Case "DC" (gasoline).

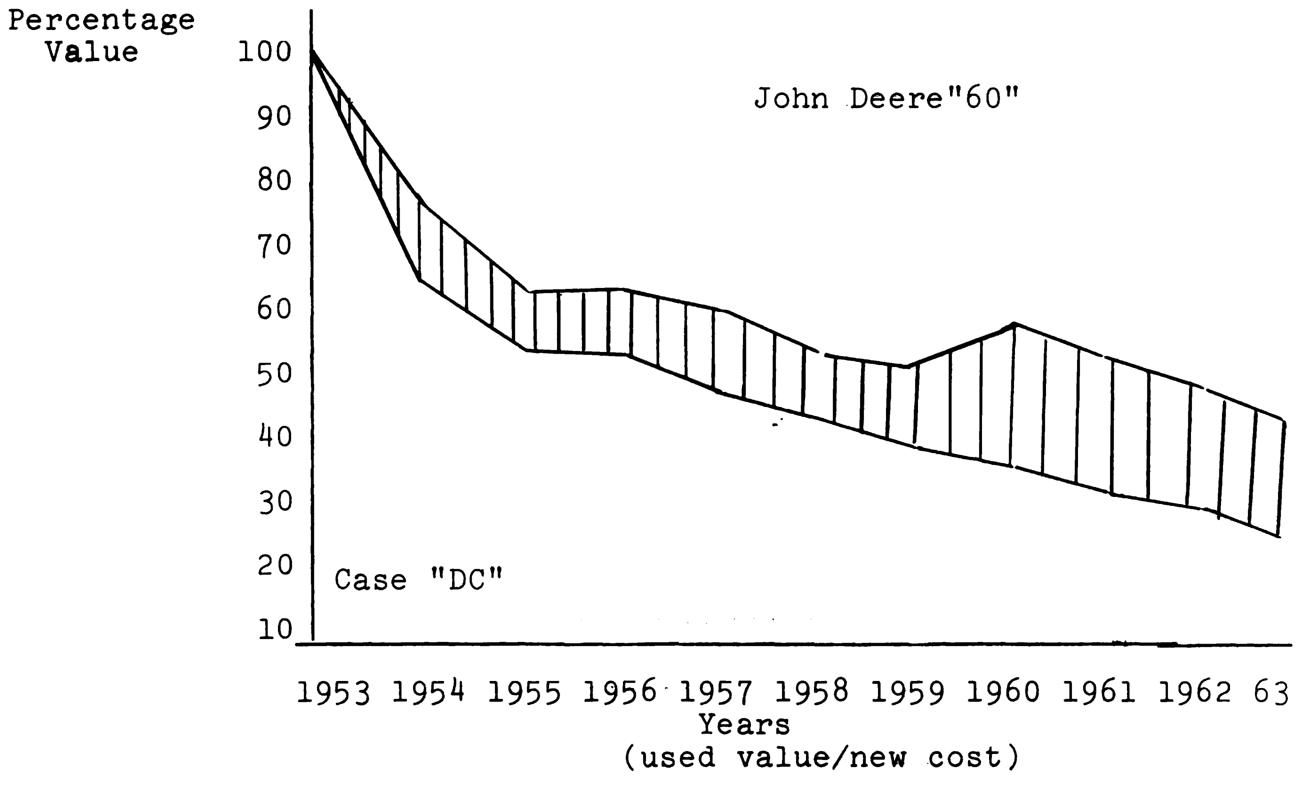

Figure 4---Percentage values of 1953 John Deere "60" and 1953 Case "DC" from 1953 to 1963.

Between these two models, the difference in value clearly becomes greater with the advancing age of the tractors.

Horsepower

The regression equations estimated that the percentage value of used tractors rated under thirty horsepower were from 2.5 to 5.0 percentage points lower than larger models of the same make. There was, however, no significant difference between the midrange of horsepower (30-40 in 1953 and 30-50 in 1958) and still larger tractors. Had 50 horsepower been chosen as the upper limit in 1953, tractors larger than this might have been found to be worth significantly less than those in the 30-50 horsepower range. This would probably be due to the fact that each of the 1953 models exceeding 50 horsepower were standard-type tractors (relatively low, four wheel design,) which is not the case with 1958 models of this size. (Three of the eight, 50 horsepower plus, models in 1958 could be purchased as tricycle units.) Perhaps the type of design is also a variable with these larger tractors.

Make and horsepower seem to be complementary variables. In two equations (not reported) where horsepower and age were the only variables, 30-horsepower was somewhat less significant and exhibited a b value of a smaller magnitude than when it was used in conjunction with makes.

Since some of the b values for make are altered substantially be the addition of horsepower, it may be difficult to see a reasonable relationship between the equations with and without the <u>horsepower</u> variable. The following table was used by the author to reconcile the results of the 1953 gasoline equations.

TABLE 15---The percentage value (used value/new cost) of five year old 1953 model tractors computed from the estimating equations with and without the horsepower effects.

Make	Horsepower Range 0-29	30-40	40 +	Without a H.P. Variable
Allis Chalmers	51.2	56.7	----	52.7
Case	39.9	44.9	45.4	42.8
Cockshutt	45.6	45.4	----	47.2
John Deere	55.0	60.0	60.5	57.6
Ferguson	52.7	----	----	52.7
Ford	62.8	----	----	62.8
International Harvester	47.4	52.4	53.0	60.9
Massey-Harris	43.3	48.3	48.8	47.2
Oliver	41.4	46.4	46.9	45.2
Minneapolis Moline	40.1	45.1	45.7	44.0

Note that the upward adjustment of the b value for Ford and Ferguson simply offset the negative value of being under thirty horsepower.

In summary, it seems reasonable to expect small tractors (less than thirty horsepower) to have percentage values of 2.5 to 5.0 percentage points below larger tractors, but horsepower differences among the larger tractors (thirty horsepower and above) probably will not have any effect on their used values.

New Models

The new models variable was tried with 1958 gasoline and diesel tractors and in neither case was it significant. On this basis it was not tried with 1953 models. The example of the Allis Chalmers models in 1958 (as discussed under the interpretation of the make variables) illustrates some of the difficulties of determining when one model is replaced by another. And at the same time it seems to represent reason for continuing to believe that new models do have an effect on the value of the older models. Perhaps the criterion of determining when one model had superseded another---the first year after the older model is discontinued---was incorrect, or perhaps a new model in one make affects the value of older models in all other makes. It might well be argued that the lack of significance of this variable is more likely the result of its construction than the hypothesis.

Labor

The average hourly wage rate for farm workers, used as the measure of labor costs, was highly intercorrelated with the age variable (from .9892 to .9952). This alone would have made the effect of farm labor costs difficult to interpret. The variable was even less useful because it lacked significance in all but the 1953 Y_1 gasoline equation. The combination of intercorrelation and general lack of significance persuaded the author to omit labor as a variable in the final equations.

Inflation

Since the variable inflation is embodied in the dependent variable Y_2, the process of analysis is somewhat indirect. The effect of inflation on the rate of "loss-in'value" may be obtained by subtracting Y_2 equations from comparable Y_1 equations. The difference calculated for 1953 models (gasoline and diesel) ranges from 0.898 to 1.168, averaging 1.023. The range for 1958 models is from 0.488 to 0.740, averaging 0.647. In short, this means that the value of the farmer's tractor in "real" dollars declines approximately 0.5% to 1.0% per year faster than the decrease he observes in current dollars. By the time the tractor is ten years of age, nearly 25.0% of its value may be attributed to inflation.

One might ask if the change in b value is exactly equal to the average percentage increase in prices. Clearly it is not (average inflation amounted to roughly 3.7%), and for a very good reason. Deflation of a percentage value does not mean decreasing it by the same number of percentage points as the given increase in the index number. For example, deflation of 50.0% by an index number of 103 yields 48.5%, not 47.0%.

Another important problem is to decide if the effect of inflation is significant. Such a decision must be made somewhat subjectively, due to the lack of any statistical test to use in this particular circumstance. With this in mind, it seems reasonable to consider the effect of inflation to be quite significant given the improved fit of the various equations to the deflated dependent variable. With each given equation, the R^2 resulting from the use of Y_2 is substantially greater than that for Y_1. For the purposes of this study, the effect of inflation on used tractor values will be considered significant.

Curvilinear Functions

As noted earlier in the chapter, the addition of age squared was a significant improvement in fit for gasoline tractor equations, but not for the majority of the diesel tractors. It is the author's conclusion that this situation is more likely a matter of circumstance than any characteristic difference between "loss-in-value" of diesel and gasoline tractors. The reasoning behind this statement is as follows (1) One could easily rationalize a situation where age squared was significant for all 1953 equations, but not significant for any of the 1958 equations. Curvilinearity of the "loss-in-value" function is more likely to be discovered by equations over a long span of time than those covering a shorter period. One unusual year included by the 1958-1963 equations could even result in an age squared value with a negative sign (as is found in the 1958 Y_1 diesel equation). (2) The possibility that 1953 diesel equations (with relatively low constants and b values for age) indicate a growing acceptance of diesel tractors has previously been discussed. The uniqueness of this equation, in the Y_1 form, may be an explanation for its evident lack of curvilinearity. (Note that while age squared was significant for the 1953 diesel Y_2 equation, it did not have a numerically large effect on used values. A 1953 John Deere diesel at 5 years of age would be worth based on "real" dollars, 48.4% of its original cost as estimated by the linear equation #20 and 47.6% by the curvilinear equation #28.)

Since curvilinear equations were a better "fit" to gasoline tractor values, it would be well to record the yearly "loss-in-value" as computed from one of these equations. (See Table 16).

Even the curvilinear model was not sufficient to eliminate all traces of curvilinearity in the average residuals for each year. Although the pattern is somewhat different than for the linear model, it is no less evident. (See Table 17.)

TABLE 16---Yearly "loss-in-value" for 1953 gasoline tractors, as a percent of their original cost, computed from equations #25 and 26.[a]

	Years of Age									
Equation	1	2	3	4	5	6	7	8	9	10
	(percent)									
1953 Gasoline Y_1 (current $'s)	40.25	4.80	4.36	3.92	3.48	3.04	2.51	2.25	1.72	1.28
1953 Gasoline Y_2 (constant$'s)	37.23	7.00	6.38	5.56	4.84	4.12	3.39	2.68	1.96	1.24

[a]The above information involves only the age variables.

TABLE 17---Average yearly residuals (actual value--estimated value) for equation #25.

MODEL	Years of Age 1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
				Percent						
1953 Gasoline	3.15	-2.14	-1.08	-1.65	-1.48	2.05	2.57	1.03	0.32	-1.06

This was no doubt due to the mathematical restrictions of the squared term.

Summary

As expected, age was the most important variable for explaining used tractor values. Alone it accounts for 57% to 87% of the variation in these values. The other useful variables seem to be complementary to age, not substitutes for it.

Changes in realized net farm income seem to have little or no effect on used tractor values. Farm prices, as measured by the U.S.D.A. "prices received index," also seem to have no effect on used tractor values. A high intercorrelation between this variable and age, however, makes this finding less conclusive than it might have otherwise been. Labor, representing the effect of farm labor costs on used values, is another variable which is highly intercorrelated with age and lacks significance in most cases. The new model variables were still another group which did not have any significant effect on used tractor values.

Make, however, was very useful in explaining used tractor values. The addition of make variables markedly improved the fit of the regression equations. (For example, R^2s for 1953 gasoline models increased from 0.5743 to 0.7931 as a result of including make.) On the other hand, make is not very helpful for predicting used tractor values as no 1-2-3,---n ranking of the various makes was possible.

There seems to be sufficient evidence to think of the effect of make as being a function of time. This is consistent with the idea that time is necessary to disseminate information about numerous models of tractors.

Tractors with less than thirty horsepower, one might label them as "small tractors," were worth an average 2.5% to 5.0% of their original cost less in each year than the larger models. Above this horsepower level, the size of the model seems to have no significant effect on its used value.

Inflation represents an important part of used tractor values based on current dollars. The "real" value of farm tractors declines from 0.5 to 1.0 percentage points faster than their current dollar values. The regression equations for deflated values of farm tractors are capable of explaining a considerably larger portion of the variation in used values than those for current values with exactly the same variables.

The "loss-in-value" function is in general curvilinear. Linear equations for the five-year span, therefore, record larger constants and b values for age than comparable ones representing the longer period.

The following recapitulation of used values, in percent of original costs, and rates of "loss-in-value," on the same basis, should give some idea of what to expect in the future. (All the figures given below are for gasoline tractors; diesels may be expected to lose value somewhat more rapidly.) The simplest linear equations, Y = f (Age), for the 1953 models, indicates that at one year of age a tractor would be worth 61.2% of its original cost. The average residuals computed for this equation suggests that the value may be 5.7 percentage points too low. By contrast, the same equation for 1958 models gives a first year value of 70.25%, which is expected to be underestimated by 0.6 percentage points. These represent an overall estimate for all makes. The complete curvilinear model estimated a first year value 59.8% of original cost and was expected (based on average residuals) to be 3.2 percentage points too low. This estimate was based on the lowest valued make (which was Minneapolis Moline) and a horse-power rating in excess of thirty. The comparable linear model yields an estimate of 57.4%. The same equations computed for 1958 models of a five-year period give estimates of 67.8% and 66.6%, curvilinear and linear models respectively.

Linear estimates of the yearly "loss-in-value" (from the second year on) are about the same regardless the completeness of the equations, 3.1% of original value over the ten-year period and about 4.4% for the five-year span. The curvilinear estimates range from 4.8% down to 1.3% as measured for 1953 to 1963, and 7.3% to 3.0% for 1958 models over the shorter span.

Estimates of the so-called "salvage value" (value at the end of ten years) range 29.8% (without adjustment for differential values for make)to 33.6% (average over all makes and horsepower ratings.)

CHAPTER IV

ANALYSIS OF USED COMBINE VALUES

INTRODUCTION

The analysis of used combine values proceeds in much the same way as Chapter III's examination of used tractor values. Most of the variables that were hypothesized to effect tractor values are also applicable to combines. Other variables, more specific to combines, were of course added. Again, the machines studied were manufactured in either 1953 or 1958, and analyzed over the time periods 1953 to 1963 and 1958 to 1963 respectively.

The sample of combines was divided into subsamples consisting of pull type and self propelled units. These subsamples were then analyzed using separate equations. Although pull type and self propelled units are obviously interchangeable for harvesting operations, they are quite different technically. Such technical dissimilarities would be of little consequence if both types displayed the same "loss-in-value" characteristics. However, the author hypothesized that this was not the case.

VARIABLES

The rationale for those variables common to both the tractor and combine analysis will not be repeated here. (For elaboration of the variables: age, realized net farm income, inflation, make, and new models see the variables section of chapter III.)

The variables introduced with this chapter are engine driven, and combined acreage.

Engine Driven

The engine driven combine (engine used only to power the threshing mechanism, not self propelled), as opposed to the power take-off (PTO) models, can be thought of as consisting of two separate components, threshing apparatus and engine. In this sense it is necessary to consider what effect the engine might have on "loss-in-value" of the total machine. Since the original purchase cost of an engine driven combine is substantially larger than a comparable PTO unit, it seemed reasonable to introduce a variable to determine what this effect might be.

Specification of whether the combine was PTO or engine driven was done using a single dummy variable. (For explanation of dummy variables see the discussion under make in the variables section of Chapter III). A one was entered for each observation of an engine driven unit and a zero for each PTO unit.

Combined Acreage

The number of acres of crops harvested by combines could be expected to affect the used values of both pull-type and self propelled combines. With changes in the level of production of these crops, one expects a change in the amount of productive inputs used. Increased acreage would no doubt require expanded use of fertilizer, seed, and sprays with these particular crops. It would seem reasonable that greater harvesting capacity would also be desired, thus strengthening the demand for new and used combines. The logical consequence of this would be higher values for used combines. As a result of this reasoning the variable combined acreage was included.

Because wheat represents a large share of crop acreage harvested by combines, it might have been sufficient to use wheat acreage harvested as the variable. However, the author thought it more realistic to use a consolidation of all the crops normally harvested with combines. The crops included in the composite were wheat, oats, soybeans, rye, flaxseed, barley, and dry edible beans.

Two assumptions were made regarding the design of this variable. (1) There is no competing harvest technology for these crops. (2) The amount of corn harvested by combines was not sufficient to be included. The first appears to be quite realistic, but the second was made out of necessity. Information about the number of acres of corn harvested by combines was not available at the time of this study.

The numerical sum of the harvested acreage for this composite of crops was used as the combined acreage variable.

ESTIMATING EQUATIONS

Y = f (Age)

The following are equations for the regresssion of the dependent variables, Y_1 and Y_2, on the single variable age. Note that again Y_1 is the percentage of the original purchase price represented by the used value and Y_2 is this same percentage value deflated by the appropriate Bureau of Labor Statistics wholesale price index.

1953 Pull Type Combine

Equation #33 $\hat{Y}_1 = \underset{(1.216)}{61.883} - \underset{(0.210)}{4.439}X_1$**

$R^2 = 0.7865$ S.E. = 6.1633

Equation #34 $\hat{Y}_2 = \underset{(1.227)}{60.552} - \underset{(0.212)}{5.142}X_1$**

$R^2 = 0.8293$ S.E. = 6.2180

1958 Pull Type Combines

Equation #35 $\hat{Y}_1 = \underset{(0.841)}{73.847} - \underset{(0.277)}{7.328}X_1$**

$R^2 = 0.8339$ S.E. = 4.4271

Equation #36 $\hat{Y}_2 = \underset{(0.756)}{71.546} - \underset{(0.250)}{7.809}X_1$**

$R^2 = 0.8756$ S.E. = 3.9834

1953 Self Propelled Combines

Equation #37 $\hat{Y}_1 = \underset{(1.380)}{60.666} - \underset{(0.221)}{3.731X_1}$**

$R^2 = 0.7262$ S.E. = 6.5961

Equation #38 $\hat{Y}_2 = \underset{(1.268)}{59.775} - \underset{(0.203)}{4.433X_1}$**

$R^2 = 0.8161$ S.E. = 6.0597

1958 Self Propelled Combines

Equation #39 $\hat{Y}_1 = \underset{(1.308)}{70.290} - \underset{(0.389)}{5.489X_1}$**

$R^2 = 0.6884$ S.E. = 5.2327

Equation #40 $\hat{Y}_2 = \underset{(1.211)}{68.235} - \underset{(0.360)}{5.905X_1}$**

$R^2 = 0.7489$ S.E. = 4.8463

(Where X_1 equals age, * means significant at .05 , ** at .01)

In all cases the b values for the variable age are significant, in fact they are all significant at the .001 level. There remains little doubt as to the importance of age as an explanatory variable.

There are certain other things to consider in the above equations. First, note that b values for Y_2 equations are numerically larger than those for comparable Y_1 equations. The corresponding R^2 values indicate that the Y_2 equations fit the data better than Y_1 equations. The differences in these statistics, between Y_1 and Y_2 equations, measure the effect and importance of inflation for this simple model. Expectations, based on the tractor analysis, are for these conditions to be present in the more complex equations.

Again, note the difference in b values between comparable 1953 and 1958 models. The amount of the difference for Y_1 equations is 2.8891 percentage points for pull type and 2.1698 percentage points for self propelled machines. These differences are greater than half of their respective 1953 b values for age. From the experience of Chapter III one might suspect some curvilinearity in the actual "loss-in-value" function.

Finally, if the difference in b values between pull type and self propelled equations (of same time span) could be construed to mean that the estimating equations were significantly different, it would validate the author's contention that they have dissimilar "loss-in-value" characteristics and should therefore be separately studied.

Y = f (Age, Make)

The following are equations including dummy variables representing the make of the combines.

1953 Pull Type Combines

Equation #41
$$\hat{Y}_1 = \underset{(1.822)}{60.529} - \underset{(0.164)}{4.670X_1^{**}} + \underset{(2.303)}{9.526X_2^{**}} - \underset{(2.064)}{4.188X_3^{*}}$$
$$+ \underset{(2.005)}{0.843X_4} + \underset{(1.997)}{9.263X_5^{**}} + \underset{(2.242)}{0.867X_6} + \underset{(2.041)}{1.781X_7}$$
$$+ \underset{(2.242)}{3.037X_8} + \underset{(2.005)}{1.743X_9}$$

$R^2 = 0.8834$ S.E. = 4.7136

Equation #42
$$\hat{Y}_2 = \underset{(2.006)}{59.232} - \underset{(0.180)}{5.357X_1^{**}} + \underset{(2.536)}{8.188X_2^{**}} - \underset{(2.272)}{3.745X_3}$$
$$+ \underset{(2.207)}{1.240X_4} + \underset{(2.198)}{8.411X_5^{**}} + \underset{(2.468)}{1.402X_6} + \underset{(2.247)}{1.094X_7}$$
$$+ \underset{(2.468)}{3.322X_8} + \underset{(2.207)}{1.884X_9}$$

$R^2 = 0.8890$ S.E. = 5.1888

X_1 = Age
X_2 = Allis Chalmers
X_3 = Gleaner Baldwin
X_4 = Case
X_5 = John Deere
X_6 = Ford
X_7 = International Harvester
X_8 = Massey Harris
X_9 = Oliver

(Minneapolis Moline is the base for make comparisons.)

1958 Pull Type Combine

Equation #43
$$\hat{Y}_1 = \underset{(1.404)}{72.186} - \underset{(0.269)}{7.328X_1^{**}} + \underset{(1.682)}{3.415X_2^{*}} + \underset{(1.404)}{0.108X_3}$$
$$+ \underset{(2.257)}{4.019X_4} + \underset{(1.682)}{3.685X_5^{*}} + \underset{(1.601)}{3.326X_6^{*}} + \underset{(1.601)}{1.651X_7}$$
$$+ \underset{(1.477)}{0.659X_8} + \underset{(1.927)}{2.863X_9}$$

$R^2 = 0.8532$ S.E. = 4.2872

Equation #44
$$\hat{Y}_2 = \underset{(1.272)}{70.097} - \underset{(0.244)}{7.818X_1^{**}} + \underset{(1.524)}{3.431X_2^{*}} + \underset{(1.273)}{0.275X_3}$$
$$+ \underset{(2.046)}{3.918X_4} + \underset{(1.524)}{3.315X_5^{*}} + \underset{(1.452)}{1.595X_6} + \underset{(1.452)}{1.707X_7}$$
$$+ \underset{(1.339)}{0.714X_8} + \underset{(1.747)}{2.714X_9}$$

$R^2 = 0.8884$ S.E. 3.8867

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = Ford

X_7 = International Harvester

X_8 = Massey-Ferguson

X_9 = Oliver

(Minneapolis Moline is the base for make comparisons)

1953 Self Propelled Combines

Equation #45
$$\hat{Y}_1 = \underset{(1.829)}{55.404} - \underset{(0.168)}{3.742X_1^{**}} + \underset{(2.296)}{7.651X_2^{**}} + \underset{(2.233)}{2.530X_3}$$
$$+ \underset{(1.934)}{0.305X_4} + \underset{(2.233)}{13.790X_5^{**}} + \underset{(2.233)}{4.230X_6} + \underset{(1.824)}{8.897X_7^{**}}$$
$$+ \underset{(2.233)}{4.550X_8^{*}}$$

$R^2 = 0.8533$ S.E. = 4.9940

Equation #46
$$\hat{Y}_2 = \underset{(1.802)}{55.614} - \underset{(0.165)}{4.442X_1^{**}} + \underset{(2.262)}{6.119X_2^{**}} + \underset{(2.200)}{1.580X_3}$$
$$- \underset{(1.906)}{0.360X_4} + \underset{(2.200)}{11.350X_5^{**}} + \underset{(2.200)}{2.930X_6} + \underset{(1.797)}{7.267X_7^{**}}$$
$$+ \underset{(2.200)}{3.500X_8}$$

$R^2 = 0.8867$ S.E. = 4.9201

X_1 = age

X_2 = Allis Chalmers

X_3 = Gleaner Baldwin

X_4 = Case

X_5 = John Deere

X_6 = International Harvester

X_7 = Massey-Harris

X_8 = Oliver

(Minneapolis Moline is the base for make comparison)

1958 Self Propelled Combines

Equation #47 $\hat{Y}_1 = 66.012 - 5.577X_1^{**} + 1.160X_2 + 10.040X_3^{**}$

$\quad\quad\quad\quad(1.689)\quad(0.325)\quad\quad(1.689)\quad(2.388)$

$+ 3.380X_4 + 8.707X_5^{**} + 6.302X_6^{**}$

$\quad(1.950)\quad(1.836)\quad\quad(1.806)$

$+ 5.627X_7^{**} + 5.080X_8^{*}$

$\quad(1.780)\quad\quad(2.388)$

$R^2 = 0.8005$ S.E. = 4.3602

Equation #48 $\hat{Y}_2 = 64.301 - 5.987X_1^{**} + 1.135X_2 + 9.480X_3^{**}$

$\quad\quad\quad\quad(1.571)\quad(0.302)\quad\quad(1.571)\quad(2.222)$

$+ 3.180X_4 + 8.042X_5^{**} + 5.751X_6^{**}$

$\quad(1.814)\quad(1.707)\quad\quad(1.680)$

$+ 4.967X_7^{**} + 4.680X_8^{*}$

$\quad(1.656)\quad\quad(2.222)$

$R^2 = 0.8378$ S.E. = 4.0561

X_1 = age $\quad$ X_4 = Cockshutt $\quad$ X_7 = Massey-Ferguson

X_2 = Allis Chalmers $\quad$ X_5 = John Deere $\quad$ X_8 = Oliver

X_3 = Case $\quad$ X_6 = International Harvester

(Minneapolis Moline is the base for make comparisons.)

As in the tractor analysis, those makes which exhibit b values significantly different from zero can be thought of as having significantly greater or smaller used values than the Minneapolis Moline combines. Examining the above equations one will find the significant makes to be the ones listed below.

1953 Pull Type -Y_1

(+) Allis Chalmers**

(-) Gleaner Baldwin*

(+) John Deere*

1953 Pull Type-Y_2

(+) Allis Chalmers**

(+) John Deere

1953 Self Propelled-Y_1

(+) Allis Chalmers**

(+) John Deere**

(+) Massey Harris**

(+) Oliver*

1953 Self Propelled-Y_2

(+) Allis Chalmers**

(+) John Deere**

(+) Massey Harris**

1958 Pull Type-Y_1

(+)Allis Chalmers*

(+) John Deere*

(+) Ford*

1958 Pull Type-Y_2

(+) Allis Chalmers*

(+) John Deere *

1958 Self Propelled-Y_1

(+) Case**

(+) John Deere*

(+) International Harvester**

(+) Massey-Ferguson**

(+) Oliver*

1958 Self Propelled-Y_2

(+) Case**

(+) John Deere

(+) International Harvester**

(+) Massey Ferguson**

(+) Oliver*

(A plus means the make was significantly different in a positive direction, a negative means the reverse, * means significance at .05 level, while ** means significance at .01 level.)

John Deere was the only make that was significantly different from zero (Minneapolis-Moline) in all cases. Allis Chalmers was significant in all the pull type equations, but not in all the self propelled equations. The opposite was true of Massey Harris. There is little more that can be ascertained about makes from the equations themselves.

Even though addition of the make variables increases the R^2 values of the estimating equations (compare R^2's for equations 38-40 with those for 41-48, there is room for reasonable doubt about the significance of their contribution. Remember that make is not one, but several variables added to the equation. Therefore it is useful to test the significance of the make variables in aggregate. The following F-test was used to do this.

$$F(d.f.=r-k \text{ and } n-r-1)=\frac{\dfrac{\text{SSR with make variables}-\text{SSR without make variables}}{(r-k)}}{\dfrac{\text{SSE } (n-r-1)}{(n-r-1)}}$$

Where: SSR=sum of squares regression, SSE=sum of squares error, n-number of observation, r-number of variables in equation including make, k-number of variables in equation without make.

The F-test indicated that the make variables were significant as a group, at the .01 level, for all but 1958 pull type models. The aggregate of make variables was significant at the .05 level for the Y_1 equation representing those models, but was not significant (.10 level) for the Y_2 equation.

Y = f (Age, Make, Engine Driven)

The following equations include the variable engine driven. This, of course, applies only to the pull type combines.

1953 Pull Type Combines

$$\text{Equation \#49}\quad \hat{Y}_1 = \underset{(2.050)}{63.563} - \underset{(0.159)}{4.704X_1^{**}} + \underset{(2.434)}{6.696X_2^{**}} - \underset{(2.067)}{5.718X_3^{**}}$$

$$- \underset{(2.017)}{0.739X_4} + \underset{(1.897)}{7.941X_5^{**}} - \underset{(2.381)}{1.979X_6} + \underset{(2.038)}{0.341X_7}$$

$$+ \underset{(2.382)}{0.191X_8} + \underset{(2.017)}{0.161X_9} - \underset{(0.991)}{2.881X_{10}^{**}}$$

$R^2 = 0.8916$ S.E. = 4.5653

$$\text{Equation \#50}\quad \hat{Y}_2 = \underset{(2.268)}{62.348} - \underset{(0.175)}{5.392X_1^{**}} + \underset{(2.693)}{5.285X_2} - \underset{(2.287)}{5.317X_3^{**}}$$

$$- \underset{(2.231)}{0.383X_4} + \underset{(2.198)}{7.055X_5^{**}} - \underset{(2.635)}{1.520X_6} - \underset{(2.254)}{0.385X_7}$$

$$+ \underset{(2.635)}{0.401X_8} + \underset{(2.231)}{0.261X_9} - \underset{(1.096)}{2.957X_{10}^{**}}$$

$R^2 = 0.8958$ S.E. = 5.0504

X_1 = age
X_2 = Allis Chalmers
X_3 = Gleaner Baldwin
X_4 = Case
X_5 = John Deere
X_6 = Ford
X_7 = International Harvester
X_8 = Massey Harris
X_9 = Oliver
X_{10} = Engine Driven

(Minneapolis Moline is the base for make comparisons.)

1958 Pull Type Combines

Equation #51 $\hat{Y}_1 = 72.860 - 7.404X_1^{**} + 3.126X_2 - 0.034X_3$

$\qquad (1.575) \quad (0.281) \quad (1.710) \quad (1.413)$

$+ 3.573X_4 + 3.685X_5^{*} + 3.134X_6 + 1.459X_7$

$\qquad (2.307) \quad (1.682) \quad (1.615) \quad (1.615)$

$+ 0.467X_8 + 2.671X_9 - 0.753X_{10}$

$\qquad (1.491) \quad (1.938) \quad (0.797)$

$R^2 = 0.8542$ $\qquad$ S.E. = 4.2890

Equation #52 $\hat{Y}_2 = 70.357 - 7.848X_1^{**} + 3.319X_2^{*} + 0.220X_3$

$\qquad (1.432) \quad (0.256) \quad (1.555) \quad (1.284)$

$+ 3.746\ X_4 + 3.315X_5^{*} + 1.521X_6 + 1.633X_7$

$\qquad (2.097) \quad (1.529) \quad (1.468) \quad (1.468)$

$+ 0.640X_8 + 2.640X_9 - 0.291X_{10}$

$\qquad (1.356) \quad (1.762) \quad (0.725)$

$R^2 = 0.8885$ $\qquad$ S.E. = 3.8992

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = Ford

X_7 = International Harvester

X_8 = Massey-Ferguson

X_9 = Oliver

X_{10} = Engine Driven

(Minneapolis Moline is the base for make comparisons)

Engine Driven was significant variable in the 1953 equation, but not in 1958. The 1953 engine driven combines appear to have percentage values almost 3.00 points below their PTO counterparts. The b value for engine driven was also negative in 1958, but was numerically too small to be of consequence.

Comparing equations 49-52 and 41-44, it is readily apparent that dividing the combines into engine driven and PTO causes some adjustment of the make variables. Note these shifts in the list of significant makes given below.

Y = f (Age, Make)	Y = f (Age, Make, E.D.)†
1953 Y_1---	1953 Y_1---
(+) Allis Chalmers**	(+) Allis Chalmers**
(-) Gleaner Baldwin*	(-) Gleaner Baldwin**
(+) John Deere**	(+) John Deere**
1953 Y_2---	1953 Y_2---
(+) Allis Chalmers**	(-) Gleaner Baldwin*
(+) John Deere**	(+) John Deere**
1958 Y_1---	1958 Y_1---
(+) Allis Chalmers*	(+) John Deere*
(+) John Deere*	
(+) Ford*	
1958 Y_2---	1958 Y_2---
(+) Allis Chalmers*	(+) Allis Chalmers*
(+) John Deere*	(+) John Deere*

(†ED = Engine Driven.)

Y = f (Age, Make, Engine Driven*, New Models) *Applies to pull type only.

The task of this new model variable is to estimate the effect of introducing a new model on the used value of its' predecessor. The number of variables necessary is dependent upon the number of comparable new models succeeding the combine model studied. For example if the John Deere "55" self propelled combine has four replacements between 1953 and 1963., four variables will be needed. The equations, then, vary in the number of new model variables used.

1953 Pull Type Combines

Equation #53 $\hat{Y}_1 = 66.052 - 4.362X_1^{**} + 5.112X_2 - 5.496X_3$
$(2.858)\quad(0.203)\quad(2.813)\quad(2.870)$

$- 1.101X_4 + 6.009X_5^{**} - 3.248X_6 + 0.244X_7$
$(2.754)\quad(2.311)\quad(2.835)\quad(2.467)$

$- 0.657X_8 - 1.051X_9 - 4.340X_{10}^{**} - 3.325X_{11}^{*}$
$(2.616)\quad(2.598)\quad(1.733)\quad(1.551)$

$- 0.981X_{12} + 0.410X_{13} - 2.393X_{14}$
$(1.648)\quad(4.795)\quad(1.513)$

$R^2 = 0.8990$ S.E. = 4.4881

Equation #54 $\hat{Y}_2 = 65.601 - 5.016X_1^{**} + 3.714X_2 - 5.165X_3$
$(3.142)\quad(0.223)\quad(3.093)\quad(3.155)$

$- 0.870X_4 + 5.125X_5^{**} - 3.265X_6 - 0.891X_7$
$(3.027)\quad(2.540)\quad(3.117)\quad(2.712)$

$- 0.492X_8 - 1.137X_9 - 5.139X_{10}^{**} - 4.432X_{11}^{**}$
$(2.876)\quad(2.856)\quad(1.904)\quad(1.704)$

$+ 0.013X_{12} + 0.939X_{13} - 2.392X_{14}$
$(1.811)\quad(5.271)\quad(1.663)$

$R^2 = 0.9041$ S.E. = 4.9335

X_1 = age
X_2 = Allis Chalmers
X_3 = Gleaner Baldwin
X_4 = Case
X_5 = John Deere
X_6 = Ford
X_7 = International Harvester
X_8 = Massey Harris
X_9 = Oliver
X_{10} = Engine Driven
X_{11} = New Model #1
X_{12} = New Model #2
X_{13} = New Model #3
X_{14} = Discontinuation of the line

(Minneapolis Moline is the base for make comparisons)

1958 Pull Type Combines

Equation #55 $\hat{Y}_1 = 72.379 - 6.422X_1^{**} + 0.943X_2 + 3.034X_3^{*}$
$(1.402)\ (0.300)\ (1.559)\ (1.343)$

$+ 2.735X_4 + 2.181X_5 + 2.587X_6 + 1.134X_7$
$(2.065)\ (1.508)\ (1.423)\ (1.421)$

$+ 0.363X_8 + 0.665X_9 - 0.996X_{10} - 3.804X_{11}^{**}$
$(1.321)\ (1.748)\ (0.703)\ (0.845)$

$- 4.389X_{12}^{**} - 4.068X_{13}^{**}$
$(1.519)\ (1.222)$

$R^2 = 0.8901$ S.E. = 3.7667

Equation #56 $\hat{Y}_2 = 69.976 - 6.974X_1^{**} + 1.329X_2 + 2.894X_3^{*}$
$(1.285)\ (0.275)\ (1.428)\ (1.230)$

$+ 2.948X_4 + 1.948X_5 - 1.018X_6 + 1.345X_7$
$(1.891)\ (1.382)\ (1.303)\ (1.302)$

$+ 0.566X_8 + 0.806X_9 - 0.502X_{10} - 3.520X_{11}^{**}$
$(1.210)\ (1.601)\ (0.644)\ (0.774)$

$- 3.599X_{12}^{**} - 3.606X_{13}^{**}$
$(1.391)\ (1.119)$

$R^2 = 0.9147$ S.E. = 3.4503

X_1 = age	X_6 = Ford	X_{11} = New Model #1
X_2 = Allis Chalmers	X_7 = International Harvester	X_{12} = New Model #2
X_3 = Case	X_8 = Massey Ferguson	X_{13} = Discontinuation of the line
X_4 = Cockshutt	X_9 = Oliver	
X_5 = John Deere	X_{10} = Engine Driven	

(Minneapolis Moline is the base for make comparisons.

1953 Self Propelled Combines

Equation #57
$$\hat{Y}_1 = \underset{(2.011)}{55.096} - \underset{(0.285)}{3.715X_1^{**}} + \underset{(2.646)}{8.244X_2^{**}} + \underset{(2.472)}{2.605X_3}$$
$$+ \underset{(2.803)}{0.957X_4} + \underset{(2.691)}{13.915X_5^{**}} + \underset{(2.360)}{4.279X_6} + \underset{(1.983)}{8.956X_7^{**}}$$
$$+ \underset{(2.382)}{4.609X_8} + \underset{(1.646)}{0.100X_9} + \underset{(1.817)}{0.131X_{10}} - \underset{(3.613)}{1.562X_{11}}$$
$$- \underset{(4.507)}{1.281X_{12}} - \underset{(2.613)}{1.191X_{13}}$$

$R^2 = 0.8541$ S.E. = 5.1102

Equation #58
$$\hat{Y}_2 = \underset{(1.952)}{56.086} - \underset{(0.276)}{4.305X_1^{**}} + \underset{(2.569)}{6.959X_2^{**}} + \underset{(2.400)}{2.110X_3}$$
$$- \underset{(2.702)}{0.333X_4} + \underset{(2.612)}{10.779X_5^{**}} + \underset{(2.291)}{3.160X_6} + \underset{(1.925)}{7.276X_7^{**}}$$
$$+ \underset{(2.312)}{2.510X_8} - \underset{(1.598)}{2.200X_9} + \underset{(1.764)}{1.499X_{10}} - \underset{(3.507)}{2.022X_{11}}$$
$$+ \underset{(4.375)}{1.864X_{12}} - \underset{(2.536)}{0.964X_{13}}$$

$R^2 = 0.8906$ S.E. = 4.9603

X_1 = age	X_5 = John Deere	X_9 = New Model #1
X_2 = Allis Chalmers	X_6 = International Harvester	X_{10} = New Model #2
X_3 = Gleaner Baldwin	X_7 = Massey Harris	X_{11} = New Model #3
X_4 = Case	X_8 = Oliver	X_{12} = New Model #4

X_{13} = Discontinuation of the line

(Minneapolis Moline is the base for make comparisons.)

1958 Self Propelled Combines

Equation #59 $$\hat{Y}_1 = \underset{(1.682)}{65.993} - \underset{(0.342)}{4.973X_1^{**}} + \underset{(1.863)}{1.337X_2} + \underset{(2.220)}{12.050X_3^{**}}$$
$$+ \underset{(1.906)}{3.845X_4^{*}} + \underset{(1.724)}{7.878X_5^{**}} + \underset{(1.725)}{7.011X_6^{**}} + \underset{(1.744)}{4.550X_7^{**}}$$
$$+ \underset{(2.262)}{4.004X_8} - \underset{(1.115)}{1.794X_9} - \underset{(2.553)}{10.049X_{10}^{**}} - \underset{(1.512)}{3.404X_{11}^{*}}$$

$R^2 = 0.8426$ S.E. = 3.9445

Equation #60 $$\hat{Y}_2 = \underset{(1.554)}{64.444} - \underset{(0.316)}{5.385X_1^{**}} + \underset{(1.721)}{1.104X_2} + \underset{(2.051)}{11.358X_3^{**}}$$
$$+ \underset{(1.761)}{3.506X_4} + \underset{(1.593)}{7.154X_5^{**}} + \underset{(1.593)}{6.311X_6^{**}} + \underset{(1.611)}{3.798X_7^{*}}$$
$$+ \underset{(2.089)}{3.511X_8} - \underset{(1.030)}{1.948X_9} - \underset{(2.359)}{9.391X_{10}^{**}} - \underset{(1.397)}{3.249X_{11}^{*}}$$

$R^2 = 0.8738$ S.E. = 3.6442

X_1 = Age

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = International Harvester

X_7 = Massey Ferguson

X_8 = Oliver

X_9 = New Model #1

X_{10} = New Model #2

X_{11} = Discontinuation of the line

(Minneapolis Moline is the base for make comparisons.)

The new models variable would be considered very satisfactory if the results of all the equations were like those in 1958 pull type combines. In perfect accordance with the rationale for the variable, each new model was significant and represented a drop in the percentage value of the obsolete machine. By contrast, the first model change apparently had no affect on 1958 self propelled models. Yet a second change and discontinuation of the line did have a significant effect. For the 1953 models, none of the new model variables were significant. To eliminate the suspicion that the aggregate affect of the new models may be different than impression received from examining the individual variables, F-tests similar to those used with makes were calculated. These statistics support the conclusion that new model variables were significant as a group in 1958, but not in 1953.

There seems to be no obvious explanation for the variable's significance with 1958 models and lack of significance with 1953 models.

$Y = f\ (Age + Age^2, Make, Engine\ Driven^*)$------Curvilinear Model

*Applies to pull-type units only

As with tractors, there appeared to be sufficient reason for trying a curvilinear model with used combine values. For both pull-type and self propelled combines the constant and the b values for age in the 1958 equations exceeds those of

the 1953 equations. An analysis of the residuals (actual percentage value--estimated percentage value) for each year of age indicated that this was more likely due to a curvilinear loss-in-value than any real differences in the data. (Elaboration of this statement is found later in the chapter.) Thus, curvilinear equations of the form
$\hat{Y} = a + b_1X_1 + b_{1-a}X_1^2 + b_2X_2 + \text{-----}b_nX_n$ are given below.

1953 Pull Type Combines

Equation #61
$$\hat{Y}_1 = \underset{(2.108)}{70.212} - \underset{(0.580)}{8.074X_1^{**}} + \underset{(0.054)}{0.332X_1^{2**}} + \underset{(2.126)}{6.523X_2^{**}}$$
$$- \underset{(1.806)}{5.458X_3^{**}} - \underset{(1.762)}{1.025X_4} + \underset{(1.738)}{7.429X_5^{**}} - \underset{(2.082)}{2.495X_6}$$
$$+ \underset{(1.780)}{0.491X_7} - \underset{(2.082)}{0.325X_8} - \underset{(1.762)}{0.125X_9} - \underset{(0.867)}{2.580X_{10}^{**}}$$

$R^2 = 0.9180$ S.E. = 3.9878

Equation #62
$$\hat{Y}_2 = \underset{(1.922)}{72.735} - \underset{(0.529)}{10.657X_1^{**}} + \underset{(0.049)}{0.503X_1^{2**}} + \underset{(1.939)}{5.014X_2^{**}}$$
$$- \underset{(1.647)}{4.909X_3^{**}} - \underset{(1.607)}{0.831X_4} + \underset{(1.585)}{6.254X_5^{**}} - \underset{(1.899)}{2.325X_6}$$
$$- \underset{(1.624)}{0.149X_7} - \underset{(1.899)}{0.405X_8} - \underset{(1.607)}{0.186X_9} - \underset{(0.790)}{2.486X_{10}^{**}}$$

$R^2 = 0.9464$ S.E. = 3.6366

X_1 = age X_3 = Gleaner Baldwin X_6 = Ford

X_1^2 = age squared X_4 = Case X_7 = International Harvester

X_2 = Allis Chalmers X_5 = John Deere X_8 = Massey Harris

X_9 = Oliver X_{10} = Engine Driven

(Minneapolis Moline is the base for make comparisons.)

1958 Pull Type Combines

Equation #63

$$\hat{Y}_1 = \underset{(1.891)}{66.272} - \underset{(1.174)}{1.297X_1} - \underset{(0.198)}{1.055X_1^2}{**} + \underset{(1.554)}{2.961X_2}$$

$$- \underset{(1.284)}{0.191X_3} + \underset{(2.096)}{3.442X_4} + \underset{(1.529)}{3.685X_5}{*} + \underset{(1.468)}{2.948X_6}{*}$$

$$+ \underset{(1.468)}{1.273X_7} + \underset{(1.356)}{0.282X_8} + \underset{(1.762)}{2.486X_9} - \underset{(0.729)}{1.181X_{10}}$$

$R^2 = 0.8805$ S.E. = 3.8976

Equation #64

$$\hat{Y}_2 = \underset{(1.759)}{65.046} - \underset{(1.092)}{2.924X_1}{**} - \underset{(0.184)}{0.850X_1^2}{**} + \underset{(1.446)}{3.186X_2}{*}$$

$$+ \underset{(1.194)}{0.094X_3} + \underset{(1.950)}{3.640X_4} + \underset{(1.422)}{3.315X_5}{*} + \underset{(1.365)}{1.371X_6}$$

$$+ \underset{(1.365)}{1.484X_7} + \underset{(1.261)}{0.490X_8} + \underset{(1.639)}{2.490X_9} - \underset{(0.678)}{0.636X_{10}}$$

$R^2 = 0.9044$ S.E. = 3.6258

X_1 = age

X_1^2 = age squared

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = Ford

X_7 = International Harvester

X_8 = Massey Ferguson

X_9 = Oliver

X_{10} = Engine Driven

(Minneapolis Moline is the base for make comparisons.)

1953 Self Propelled Combines

Equation #65 $\hat{Y}_1 = 60.661 - 6.343X_1^{**} + 0.235X_1^{2**} + 7.973X_2^{**}$

$(2.217) \quad (0.709) \quad (0.062) \quad (2.160)$

$+ 2.530X_3 - 0.305X_4 + 13.790X_5^{**} + 4.230X_6^{*}$

$(2.100) \quad (1.818) \quad (2.100) \quad (2.100)$

$+ 8.897X_7^{**} + 4.550X_8^{*}$

$(1.714) \quad (2.100)$

$R^2 = 0.8716$ S.E. = 4.6952

Equation #66 $\hat{Y}_2 = 64.931 - 9.052X_1^{**} + 0.416X_1^{2**} + 6.688X_2^{**}$

$(1.802) \quad (0.577) \quad (0.051) \quad (1.756)$

$+ 1.580X_3 - 0.360X_4 + 11.350X_5^{**} + 2.930X_6$

$(1.707) \quad (1.478) \quad (1.707) \quad (1.707)$

$+ 7.267X_7^{**} + 3.500X_8^{*}$

$(1.393) \quad (1.707)$

$R^2 = 0.9325$ S.E. = 3.8162

X_1 = age

X_1^2 = age squared

X_2 = Allis Chalmers

X_3 = Gleaner Baldwin

X_4 = Case

X_5 = John Deere

X_6 = International Harvester

X_7 = Massey Harris

X_8 = Oliver

(Minneapolis Moline is the base for make comparisons.)

1958 Self Propelled Combines

Equation #67 $\hat{Y}_1 = 62.082 - 2.244X_1 - 0.552X_1^2{*} + 1.160X_2$

$(2.523) \quad (1.645) \quad (0.267) \quad (1.656)$

$+ 10.040X_3{**} + 3.380X_4 + 8.659X_5{**}$

$(2.343) \quad (1.913) \quad (1.801)$

$+ 6.220X_6{**} + 5.627X_7{**} + 5.080X_8{*}$

$(1.772) \quad (1.746) \quad (2.343)$

$R^2 = 0.8104$ S.E. = 4.2769

Equation #68 $\hat{Y}_2 = 61.120 - 3.290X_1{*} - 0.446X_1^2 + 1.135X_2$

$(2.362) \quad (1.540) \quad (0.250) \quad (1.551)$

$+ 9.480X_3{**} + 3.180X_4 + 8.003X_5{**}$

$(2.193) \quad (1.790) \quad (1.686)$

$+ 5.685X_6{**} + 4.967X_7{**} + 4.680X_8{*}$

$(1.659) \quad (1.634) \quad (2.193)$

$R^2 = 0.8438$ S.E. = 4.0036

X_1 = age

X_1^2 = age squared

X_2 = Allis Chalmers

X_3 = Case

X_4 = Cockshutt

X_5 = John Deere

X_6 = International Harvester

X_7 = Massey Ferguson

X_8 = Oliver

(Minneapolis Moline is the base for make comparisons.)

INTERPRETATION

The contribution of the regression equations is not limited to what may be learned from examining them individually. New and additional insights are obtained by comparing various equations, and applying certain relevant tests. This section is devoted to further analysis of the equations computed. Each variable is discussed in turn.

Age

The most notable characteristic of the age variable is its consistency throughout the estimating equations. Table 18 on the next page gives the b values for age from each of the linear equations. Recall that the age variable in all these cases was highly significant.

By using the t-test below, one can determine if the b values for any of the groups of equations given in Table 18 are significantly different.

$$t = \frac{bX_1 - bX_1'}{MSX_1 + MSX_1'}$$

Where X_1 and X_1' are age variables from different equations.

The widest differences in b values were between the 1958 pull type equations Y = f (Age) and Y = f (Age, Make, E.D., N.M.). These differences were significant at the .025 level. For all the other groups of equations the b values were not significantly different. With the exception of new models,

TABLE 18---The b values for age from all the linear equations estimated for combines---1953 and 1958

	Y=f(Age)	Y=f(Age,Make)	Y=f(Age,Make,E.D.)	Y=f(Age,Make,E.D.*,N.M.)
1953 Pull Type Y_1	-4.4390	-4.6699	-4.7043	-4.3624
1953 Pull Type Y_2	-5.1424	-5.3571	-5.3925	-5.0162
1958 Pull Type Y_1	-7.3281	-7.3283	-7.4044	-6.4222
1958 Pull Type Y_2	-7.8086	-7.8183	-7.8478	-6.9739
1953 Self Propelled Y_1	-3.7307	-3.7425	--------	-3.7148
1953 Self Propelled Y_2	-4.4328	-4.4425	--------	-4.3047
1958 Self Propelled Y_1	-5.4890	-5.5775	--------	-4.9730
1958 Self Propelled Y_2	-5.9055	-5.9867	--------	-5.3852

*ED = Engine Drive, N.M. = New Models

the variables indicated are clearly complimentary to <u>age</u>, rather than substitutes for it. One should expect some "trade-off" between <u>age</u> and <u>new models</u> as both of them are related to only downward movements of used values. If part of the decline in used values is due to the introduction of new models, the b value for <u>age</u>, in conjunction with <u>new model</u> variables, may not need to be as large as when it was assigned all the downward trend.

In chapter III it was found that the differences in b values between 1953 and 1958 equations are likely to be the result of a curvilinear "loss-in-value" function. In order to determine if this assumption is true for combines, certain explorations must be performed.

Our first concern is to determine if the equations for 1953 and 1958 are in fact significantly different. If the b values for <u>age</u> in the simplest equation-- Y = f (Age,)-- are significantly different from 1953 and 1958, there is ample reason to believe that the more involved equations will also be significantly different. The test applied to these b values is the first step in the analysis of covariance for regression equations with one variable.[1] The F statistics computed indicated that comparable 1953 and 1958 equations were sign-

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[1]See George W. Snedecor, <u>Statistical Methods</u>, (Iowa State College Press, Ames, Iowa, 1956) pp. 394 -399 for discussion of this method.

ificantly different at .005 level.

Having concluded that the 1953 and 1958 equations were significantly different, the next step is to determine if this difference is due to dissimilar data during the first five years of use. In other words, did the value of 1958 combines fall faster in this length of time than 1953 models? To answer this question the average yearly value was calculated for the first five years for both 1953 and 1958 models, and a t-test was used to find out if these average yearly values were significantly different. 1953 self propelled model averages were compared with 1958 self propelled, 1953 PTO models with 1958 PTO models, and engine driven for 1953 with those in 1958. In no case were the average yearly values significantly different.

The final step was to average the residuals consistent with each year of age and determine if a pattern of curvilinearity was present. (See Chapter III for explanation of this procedure) Average yearly residuals were calculated for 1953 pull type Y_1, 1958 pull type Y_1, 1953 self propelled Y_1, and 1958 self propelled Y_1 equations.

TABLE 19---Average residuals (actual value-estimated value) computed for each year of age from combine equations #33, 35, 37, & 39.

	Year of Age									
Combine	1	2	3	4	5	6	7	8	9	10
	(Percentage Points)									
Equation #33- 1953 Pull Type	4.8	1.8	-1.6	-3.9	-3.1	-1.5	0.3	1.9	2.0	2.2
Equation #35------- 1953 Self Propelled	4.4	1.5	-1.9	-3.0	-2.8	-3.9	2.9	3.3	1.5	1.5
Equation #37-- 1958 Pull Type	-1.7	1.3	2.0	-1.4	-.31					
Equation #39------- 1958 Self Propelled	-1.9	0.9	2.7	-1.1	-1.7					

The pattern of the residuals for 1953 equations indicates that the linear equations underestimated the average value in years one and two, overestimated the average value for years three through six, and underestimated them again for the last four years. This indicates that the first year value calculated is lower than the average first year value, and that the slope of the "loss-in-value" function is probably greater in the first few years and less in the later years than given by the linear regression equation. Although the 1958 equations do not exhibit a pattern consistent with the 1953 equations, it does not negate the hypothesis of curvilinearity over the longer span of time. The conclusion is that an appropriate curvilinear model could be expected to fit the 1953 combine data somewhat better than the linear models used here.

The simplest equations containing only age as a variable can also be used to support the author's early contention that pull type and self propelled combines should be examined separately. Using the covariance method of determining whether regression equations are significantly different (as was done previously in comparing 1953 and 1958 equations) the pull type and self propelled equations for both 1953 and 1958 were found to have significantly different b values--at the .05 and .01 levels respectively.

Realized Net Farm Income (RNFI)

This variable was significant at .05 for 1953 pull type, 1958 pull type, and 1958 self propelled combines in both the Y_1 and Y_2 formualtions, it was significant for 1953 self propelled combines in the Y_2 form, but not with Y_1. Even though it appears to be rather significant, the RNFI variable was dropped from the equations recorded in this chapter. The reason for its omission is that the variable takes on a negative sign in all the 1958 equations. Theoretically the sign for RNFI should be positive as it is in 1953. A negative sign is unacceptable as it says that with more spendable income farmers pay less for used combines.Some sort of a rationalization might be developed to explain a negative RNFI variable if it were negative in both 1953 and 1958. However, there is no reasonable way to explain a positive sign in 1953 and a negative sign in 1958.

Make

As noted earlier in this chapter the aggregate of make variables was usually significant. Also noted were those makes which were significantly different from zero in their effect on used combine values. In this section makes are examined in greater detail by using a t-test to determine which ones are significantly different from one another. The summary and conclusions of these comparisons are presented here.

By way of a general comment, make seems to be a more important consideration in the second five years than in the first five years of machine life. This concept was first suggested by the fact that the aggregate of make variables is less significant for 1958 pull type combines than for 1953 pull type combines, as measured by an F-test.

A comparison of the standard error of estimates for each year (1, 2, 3, ---, 10) from 1953 pull type combine equations $Y_1 = f$ (Age) and $Y_1 = f$ (Age, Make) also seems to support this suggestion. (See Table 20.)

TABLE 20---Standard error of estimates for each year for 1953 pull type combine equations Y_1 = f (Age)---equation #33--- and Y_1 = f (Age,Make)--equation # 41.

Equation	Years of Age 1	2	3	4	5	6	7	8	9	10
	Standard Error of Estimates									
(1) Y = f (Age) Eqn. #33	8.1	8.8	4.8	5.4	5.4	5.4	5.6	6.3	7.9	6.4
(2) Y = f (Age,Make) Eqn. #41	6.5	6.9	3.5	4.8	4.3	2.9	3.7	4.4	4.5	4.0
	Comparison in Percent									
% (2) / (1)	80.2	78.3	72.9	88.8	79.6	53.7	66.0	69.8	56.9	62.5

The table indicates the variables for make are more effective in reducing standard errors for the later part of the ten year span than the earlier part. This logically could be thought of as evidence that make is more essential for explaining the used value of older model than later model combines. This makes good sense if one reasons that the characteristics which may cause one make to be valued over another are exposed with time. The makes are proven, so to speak, over their useful life. In line with this type reasoning, it might be speculated that the relationship between makes is a function of time rather than a constant.

A thorough comparison of the individual make variables lead to these conclusions. (1) John Deere seems to have the strongest used value position. The make variable for John Deere is significantly different (at .05 level) from zero in each of the equations. If its b value was not the largest, it was not significantly different from the make having the largest b value. For 1953 pull type combines John Deere had significantly larger percentage values than all but Allis Chalmers. For self propelled combines of the same year, John Deere exhibited the largest b value and was significantly different from all other makes. (2) Allis Chalmers and John Deere were not significantly different with respect to pull type combines. The b value for Allis Chalmers was very slightly larger for 1953 models and somewhat lower with 1958 models. These two makes were valued significantly above all other 1953 pull type models, and were significantly different from Case and Minneapolis Moline for 1958 models. Allis Chalmers was exceeded in value by only John Deere for 1953 self-propelled combines, but was valued significantly below a number of the 1958 units. By 1958, Gleaner Baldwin was a part of the Allis Chalmers line. The pull type combines were the Allis Chalmers models only, while the self propelled combines were largely Gleaner Baldwin models. For the 1953 self propelled combines Allis Chalmers variable was significant at .005 level. Gleaner Baldwin, however, was not significantly different from Minneapolis Moline (zero) in the same equation. The 1958 self propelled equation gives the Allis Chalmers-Gleaner Baldwin combination as one of the two makes not significantly different from Minneapolis Moline (zero). (3) Massey-Harris (Massey-Ferguson in 1958) was quite highly regarded as a self propelled combine, but not as a pull type combine. Massey Harris was significantly different from Minneapolis Moline (zero) as a self propelled machine, yet not significant as a pull type. In the 1953 self propelled equations it had the second highest b value and a percentage value significantly higher than Case, Gleaner Baldwin and Minneapolis Moline. In 1958, Massey- Ferguson was not significantly different from Case which had the largest b value. (4) Oliver, International Harvester, and Massey Harris were never significantly different. They all tend to be significant makes with self propelled combines, but not with pull type machines. (5) Case had the highest b value for a 1958 self propelled combine, a complete reversal of its position in all other equations. Other equations, 1953 pull type, 1953 self propelled and 1958 pull type gave Case as not significantly different from Minneapolis Moline (zero). Yet the 1958 Case self propelled combine not only displayed the largest b value, but was significantly different from Allis Chalmers, Cockshutt, and Minneapolis Moline. (6) Ford (pull type only) was valued significantly above Gleaner Baldwin in the 1953 models, and Case and Minneapolis Moline in the 1958 models. It was not significantly different than most other makes. (7) 1953 Pull type Gleaner Baldwin was the only case where a make was valued at significantly less than the Minneapolis Moline. (8) Cockshutt (1958 only) was not significantly different from Minneapolis Moline.

Engine Driven

Earlier it was noted that the variable engine driven was significant for 1953 pull type combines, but not for 1958 pull type combines. Examining the 1953 data it was found that all the engine driven models had twelve foot headers, while all the PTO machines had six foot headers. By contrast twelve foot combines were a minority of the engine driven machines in 1958. At that juncture it was reasonable to ask if it was the header size of the combine, rather than its source of power (for threshing) which caused engine driven combines to be valued at almost three percentage points less than the smaller PTO machines. This could also be the reason that the variable was not significant in 1958. A second interpretation, which the author tentatively supports, it that the engine deteriorates somewhat faster than the total machine, or it becomes the object of greatest uncertainty to the purchaser of an older combine. This impliesthat the difference in percentage value between comparable engine driven and PTO combines is a positive function of time. Two observations would tend to support this conclusion. (1) The engine driven variable in 1958, although small, is also negative. This is fairly weak evidence as the variable is not significantly different from zero and thus it may have no effect for 1958 combines. (2) Comparing the residuals for each year from equations $Y_1 = f$ (Age, Make) and $Y_1 = f$ (Age, Make, Engine Driven), one observes a tendency toward a smaller mean square and standard error in the second five years than in the first. This again is not very conclusive evidence. The question of what caused engine driven to be significant in 1953, but not in 1958 will lack a definitive answer until the effect of this variable on other machines can be examined.

As should be expected, the addition of the engine driven variable caused some changes in the b values for makes as they were established in the simpler equations. Since the variable was not significant in 1958, its effect on make variables is small. In the Y_1 equation Allis Chalmers and Ford previously significant at .05, were no longer significant at that level. All other makes for both Y_1 & Y_2 equations remained fairly unchanged. The greatest differences were, of course, for 1953 models. In the Y_1 equations all makes previously significant remained significant, but b values showed considerable changes. (Compare equations 9, 10 with 17,18). In the Y_2 equation, previously significant Allis Chalmers (at .01) was no longer significant (at .06) and Gleaner Baldwin became significant (at .02). These happenings were explainable because the base model had only an engine driven entry, hence the constant of the regression was adjusted upward in amount approximately equal to the negative value of b for the engine driven variable. Even with the shifts in b values, the essential differences between makes in most cases remained the same. (This was especially true of the Y_1 equations where none of the significant differences between makes was altered by addition of the engine driven variable.)

The author used Table 21 to help understand the relationship between the b values for make variables from the 1953 pull type equations with and without the engine driven variable. From examining the values in this table, one can conclude that the information given by the equation including the engine driven variable is not incompatible with the estimates of the simpler equation. In general engine driven can be considered a useful variable.

Combined Acreage

Equations including the variable combined acreage were not recorded in this chapter, because the variable was significant in only one case--1958 pull type combines. In all the equations it has a high negative intercorrelation with age from -0.71722 to-0.90118. The total acreage of crops harvested by combines (except corn) fell, almost continuously, from 128,652,000 acres in 1954 to 110,048,000 acres in 1963. According to the rationale for this variable, part of the decline in value of combines should be attributed to this decline in acreage. It is difficult to judge reasonability of this hypothesis because of the intercorrelation problem.

TABLE 21---Percentage value estimates for one year old 1953 pull type combines as calculated by equations $Y_1 = f$ (Age, Make) and $Y_1 = f$ (Age, Make, Engine Driven)---equations numbers 41 and 49 respectively.

Make	Estimates From Eqn. #49		Estimates From Eqn. #41
	Engine Driven	PTO	
	(Used Value In Percent of Original Cost)		
Allis Chalmers	----	65.6	65.4
Gleaner Baldwin	50.3	53.1	51.7
Case	55.2	58.1	56.7
John Deere	63.9	66.8	65.1
Ford	----	56.9	56.7
International Harvester	56.3	59.2	57.6
Massey Harris	----	59.0	58.9
Minneapolis Moline	56.0	----	55.8
Oliver	56.1	59.0	57.6

New Models

There seems to be no complete explanation of why the new models variable gives reasonable and significant results for 1958, but not for 1953 models. Perhaps the criterion for deciding when one model was replaced by another (as discussed under new models in chapter III) was not satisfactory. Or perhaps a new model by one manufacturer has an effect on the existing models of other makes. The significance of this variable in 1958 does, however, reaffirm the author's contention that this type of obsolescence could be demonstrated if an adequate variable could be designed.

Inflation

Wholesale prices of new combines, according to the Bureau of Labor Statistics estimates, increased by about three percent per year between 1953 and 1963. It is reasonable to assume that, during this same period, the downward movement of used combines values was retarded by inflation. The Y_2 equations computed provide an opportunity to examine this assumption. (Recall from Chapter III that it was necessary to use the adjusted dependent variable Y_2 because of the high intercorrelation of age and whole sale prices index variables.) If inflation has an important effect on used combine values, the deflation of the dependent variable should result in numerically larger b values for age and greater coefficients of multiple determination (R^2's). Table 22 summarizes the numerical differences in b values for age from comparable Y_1 and Y_2 equations. As indicated in the table, used combine values decline from 0.4% to 0.7% faster in "real" terms than on a current dollar basis.

A comparison of the R^2 statistics for Y_1 and Y_2 equations is the only available method of judging the importance of the effect of inflation on used combine values. With the exception of 1953 pull type combine, the deflation of the dependent variable results in a substantially better fit with each equation. On this basis inflation is assumed to have an important effect on used combine values. (See Table 24)

Curvilinear Model

As noted earlier, the b values for age squared variable were negative with 1958 equations. This should not be regarded as a negation of the hypothesis that the rate of "loss-in-value", in general, declines over time. If a negative b value for age squared had been present among the 1953 equations, the theory would be the object of serious doubt. (Recall the b values for this variable were both positive and significant at the .01 level for the 1953 equations.) Even though the long run trend is one of declining rates of "loss-in-value", it doesn't seem unlikely that curvilinearity in the reverse order could occur during some given five year period. An unaccounted for upward

TABLE 22---Differences between b values for the Y_1 and Y_2 formulations of the dependent variable from selected equations for 1953 and 1958 model combines.

Model	Y=f (Age)	Y=f (Age,Make)	Y=f (Age,Make,ED)	Y=f (Age,Make, ED, NM.)	Average
1953 Pull Type	.7035	.6873	.6882	.6538	.6832
1953 Self Propelled	.7021	.7000	-----	.5899	.6640
1958 Pull Type	.4805	.4901	.4433	.5517	.4914
1958 Self Propelled	.4165	.4093	-----	.4060	.5106

*ED= Engine Driven, NM = New Models

or downward shift in used combine values in one year out of the five might be sufficient to cause a negative coefficient for the age squared variable.

It might be instructive to compare the estimates of used value and yearly "loss-in-value", both as a percent of original cost, for the linear and curvilinear models. The table number 23 does this for 1953 pull type combines.

Even though the curvilinear model is a better fit to the ten year data, a pattern is still evident in the residuals. The mathematical restrictions of the squared terms do not permit the model to meet the particular shape of the "loss-in -value" function.

Summary

Age is capable of explaining 69% to 88% of the variation in used combine values. It seems to be slightly more useful in explaining used values of pull type combines than of self propelled combines. This may be related to the fact that pull type combines lose their value at a significantly faster rate than self propelled units.

Realized net farm income is a significant variable (.05 level) in all the equations except 1953 self propelled models. However, the b value is negative for the 1958 equations. This is unacceptable, as it would indicate that farmers would

TABLE 23---Estimates of used value and yearly "loss-in-value" (both as a percent of original cost) for 1953 pull type combines, computed from equations 53 and 61.[a]

Equation	Age In Years 1	2	3	4	5	6	7	8	9	10
					Percentage Values					
Linear Model-- Eqn. # 21	61.7%	57.3%	52.9%	48.5%	44.1%	39.7%	35.3%	30.9%	26.5%	22.1%
Curvilinear Model-- Eqn. # 29	62.5%	55.4%	49.0%	43.2%	38.1%	33.7%	30.0%	26.9%	24.5%	22.7%
					Yearly Loss-In-Value					
Linear Model-- Eqn. # 21	38.3%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Curvilinear Model-- Eqn. # 29	37.5%	7.1%	6.4%	5.8%	5.1%	4.4%	3.7%	3.1%	2.4%	1.8%

[a]The effect of make and horsepower were not included in the computations

TABLE 24---Average yearly residuals (actual value--estimated value) for equation #61--a curvilinear model for 1953 pull type combines.

	Years									
Equation	1	2	3	4	5	6	7	8	9	10
(In Percentage Points)										
Eqn. #61 Curvilinear Model for 1953 Pull Type Combines	1.21	0.46	-1.03	-2.04	-1.27	0.60	1.63	1.87	-0.28	-2.83

be willing to pay less for used combines when their incomes were higher.

Make was a very useful variable for explaining used combine values. Once again the effect of make seems to vary as a function of time.

Engine driven combines had significantly lower used values than their PTO counterparts, by 3.0 percentage points, as measured over the ten year period. But, there was no significant difference between 1958 engine driven and PTO combines in the 1958 to 1963 period. It was then suggested that the engine deteriorates more rapidly than the rest of the machine, or it becomes the object of greater uncertainty to the buyer of an older combine.

There seems to be no apparent rationale for the significance of the new model variables in the 1958 equations, but not in the 1953 equations.

The "real" value of used combines declines from 0.4 to 0.7 percentage points (value measured in percent of original cost) faster than their nominal values. This was indicated by the regression, equations computed from deflated used value data. Removing inflation from the used values results in a better regression fit using exactly the same variables.

The "loss-in-value" function in the long run seems to be curvilinear with a decreasing slope. For the five year period, 1958 to 1963, the rate of "loss-in-value" appeared to be an increasing function for 1958 models.

The following summary of used values and yearly rates of decline should be some indication of what to expect for other models. Estimates of first year value for pull type combines ranged from 57.4% to 66.5% for the linear equations and was 62.5% for the curvilinear equation (unadjusted for make and engine driven.) Tenth year estimates of value for pull type machines range from 17.5 to 22.2%. Assuming a 10.0% "salvage value" is therefore quite inappropriate. The best linear estimates of yearly "loss-in-value" were from 4.4% to 4.7% over the ten year span. The curvilinear estimate ranged from 7.1% down to 1.8%.

First year estimates of self propelled combine values ranged from 56.9% to 64.8% for linear equations, and was 54.6 for the curvilinear model (unadjusted for make). The linear estimate of yearly loss-in-value was in each case 3.7% over the ten year period. Estimates of the "salvage value" were all very close to 22.0%.

ANALYSIS OF USED FORAGE HARVESTER VALUES

Chapter V

Introduction

The analysis of used forage harvester values follows the same format as the work done with tractors and combines. The models selected were again chosen from those manufactured in 1953 and 1958. The period over which the used values were studied--1953 to 1963 and 1958 to 1963--is unchanged from the previous chapters.

There are, of course, new variables introduced whose rationale need to be established, and the notable change of the "base" make from Minneapolis Moline (who did not manufacture forage harvesters for either year) to Massey Harris. These aside, the chapter is unique only in the information it provides.

Variables

The practice of describing only those variables which are introduced with a given chapter is continued here. (To review the rationale for variables common to this and earlier chapters, one will need to examine the variables sections for Chapters III and IV.)

Livestock Numbers

The forage harvester has little use outside of preparation of roughage crops for consumption by livestock. (Livestock as it is used here refers to all cattle and calves on U.S. farms---- omits sheep, hogs, and horses.) Clearly, not all technologies for providing roughage for livestock involve the forage harvester. But it does seem reasonable that a variation in livestock numbers would include farm operations using forage harvester-oriented technologies, as well as those using other technologies. Should livestock numbers increase (or decrease), the demand for inputs of the livestock business--including forage harvesters--would also increase (decrease). Increases in the overall demand for forage harvesters should result in higher values for the used machines.

Livestock numbers, as a variable, was entered in the equations as it is found in the 1965 Agricultural Statistics.[1] The statistics are in thousands of head.

Row Crop--Cutterbar--Pickup Units.

Row crop, cutterbar, and pickup are the alternative attachments for forage harvesters. The row crop is essentially

[1]U.S. Department of Agriculture, Agricultural Statistics --1965, (U.S. Government Printing Office, Washington: 1965) p. 307, Table 453.

a corn head, used for chopping corn (and possibly sorghum) for ensilage. The cutterbar attachment is used for green chopping grasses and legumes. The pickup attachment delivers windrowed hay crops to chopping units.

The variables row crop, cutterbar, and pickup are used mostly for statistical convenience. (1) It is the complete unit that is of interest in this study, not the base unit without any attachment. Yet the data source gives the values of the base units and attachments separately. Consequently, it seemed reasonable to aggregate the used values of base units and alternative attachments rather than to run separate equations, and put them together later. The variables above permitted any significant difference between the values of the alternative attachments to be ascertained. (2) In 1953, most manufacturers produced a row crop attachment, and either a cutterbar or pickup unit. In order to gain a better understanding of used values for these machines it seemed reasonable to include samples of the complete machines used for hay crop harvesting, and allow for the different technologies with a designative variable.

The variables were entered as dummy variables for cutterbar and pickup units, with row crop omitted as the basis of comparison.

Estimating Equations

$Y = f$ (age)

The following are regression equations with age as the only variable. The Y_1 equations are estimates of the percentage value of used forage harvesters based on current dollars. The Y_2 equations are equivalent estimates of percentage values in constant dollars (current dollars deflated by the Bureau of Labor Statistics wholesale indices.)

1953 Forage Harvesters

Equation #69 $\hat{Y}_1 = \underset{(0.478)}{61.478} - \underset{(0.083)}{4.274}X_1^{**}$

$R^2 = 0.8933$ S.E. = 3.9766

Equation #70 $\hat{Y}_2 = \underset{(0.486)}{59.993} - \underset{(0.085)}{4.818}X_1^{**}$

$R^2 = 0.9116$ S.E. = 4.0395

1958 Forage Harvesters

Equation #71 $\hat{Y}_1 = \underset{(0.597)}{72.363} - \underset{(0.199)}{7.737}X_1^{**}$

$R^2 = 0.8131$ S.E. = 4.8951

Equation #72 $\hat{Y}_2 = \underset{(0.571)}{71.054} - \underset{(0.190)}{8.319}X_1^{**}$

$R^2 = 0.8459$ S.E. = 4.6843

Where: X_1 = age, ** indicates significance at the .01 level, and * indicates significance at the .05 level.

The patterns present in the age equation for tractors and combines are evident here. The b's for 1958 are greater (by approximately 3.5 percentage points) than those for 1953 equations. The Y_2 equations are a better "fit" and exhibit larger b values than Y_1 equations. And of course, the variable <u>age</u> is highly significant at the .001 level.

<u>Y = f (Age, Make)</u>

The following equations include <u>age</u> and <u>make</u> variables. Bear in mind that Massey Harris is the base make (rather than Minneapolis Moline) for these equations.

1953 Forage Harvesters

Equation #73 $\hat{Y}_1 = 59.446 - 4.281X_1^{**} + 1.978X_2^{**} + 0.736X_3$

(0.680) (0.072) (0.811) (0.811)

$- 0.064X_4 + 3.064X_5^{**} + 5.866X_6^{**} + 4.914X_7^{**}$

(0.811) (0.811) (0.867) (0.811)

$- 0.275X_8 + 2.253X_9^{**}$

(0.811) (0.811)

$R^2 = 0.9221$ S.E. = 3.4415

Equation #74 $\hat{Y}_2 = 57.826 - 4.824X_1^{**} + 2.781X_2^{**} + 1.283X_3$

(0.722) (0.077) (0.861) (0.861)

$+ 0.614X_4 + 3.150X_5^{**} + 5.426X_6^{**} + 4.886X_7^{**}$

(0.861) (0.861) (0.921) (0.861)

$+ 0.175X_8 + 2.194X_9^{**}$

(0.861) (0.861)

$R^2 = 0.9295$ S.E. = 3.6539

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = Fox

X_6 = Gehl

X_7 = International Harvester

X_8 = New Holland

X_9 = Papec

(Massey Harris is the base for make comparisons.)

1958 Forage Harvester

Equation #75
$$\hat{Y}_1 = \underset{(0.998)}{69.808} - \underset{(0.151)}{7.723X_1^{**}} + \underset{(1.307)}{3.578X_2^{**}} - \underset{(1.070}{0.679X_3}$$
$$- \underset{(1.193)}{5.501X_4^{**}} + \underset{(1.193)}{0.078X_5} + \underset{(1.193)}{6.328X_6^{**}} + \underset{(1.052)}{2.866X_7^{**}}$$
$$+ \underset{(1.193)}{4.024X_8^{**}} + \underset{(1.193)}{5.032X_9^{**}} + \underset{(1.087)}{6.601X_{10}^{**}}$$
$$+ \underset{(1.492)}{6.862X_{11}^{**}} + \underset{(1.076)}{2.652X_{12}^{**}}$$

$R^2 = 0.8968$ S.E. = 3.6955

Equation #76
$$\hat{Y}_2 = \underset{(0.973)}{68.570} - \underset{(0.148)}{8.301X_1^{**}} + \underset{(1.273)}{3.563X_2^{**}} - \underset{(1.043)}{0.675X_3}$$
$$- \underset{(1.162)}{5.044X_4^{**}} + \underset{(1.162)}{0.227X_5} + \underset{(1.162)}{5.877X_6^{**}} + \underset{(1.025)}{2.826X_7^{**}}$$
$$+ \underset{(1.162)}{3.844X_8^{**}} + \underset{(1.162)}{4.852X_9^{**}} + \underset{(1.059)}{6.139X_{10}^{**}}$$
$$+ \underset{(1.453)}{6.672X_{11}^{**}} + \underset{(1.048)}{2.640X_{12}^{**}}$$

$R^2 = 0.9118$ S.E. = 3.6005

X_1 = age	X_5 = John Deere	X_9 = International Harvester
X_2 = Allis Chalmers	X_6 = Ford	X_{10} = New Holland
X_3 = Case	X_7 = Fox	X_{11} = Oliver
X_4 = Cockshutt	X_8 = Gehl	X_{12} = Papec

(Massey Harris is the base for make comparison.)

Since again certain makes were not significantly different from zero, it was considered worthwhile to investigate the significance of the make variables in aggregate. F-tests of the type used in earlier chapters indicated that the total contribution of make was significant at .005 level for both 1953 and 1958.

The following is a summary of makes whose effect on the equations was significantly different from Massey-Harris.

1953 Forage Harvesters	1958 Forage Harvesters
(+) Allis Chalmers**	(+) Allis Chalmers**
(+) Fox **	(-) Cockshutt**
(+) Gehl**	(+) Ford**
(+) International Harvester**	(+) Fox**
(+) Papec**	(+) Gehl**
	(+) International Harvester**
	(+) New Holland**
	(+) Oliver**
	(+) Papec**

(Where (+) or (-) indicates in which direction the effect of the make is significantly different from zero, ** indicates it is significantly different at .01 level.)

One might note that three of the makes--Ford, Oliver, Cockshutt-- listed under 1958 forage harvesters were not available in 1953.

Setting these aside, the field of makes significantly different from Massey-Harris (zero) were consistent, excepting New Holland, for the two model years. Any further comparison of the makes is reserved until later in the chapter.

Y = f (Age, Make, New Models.)

To avoid confusion, a discussion of the reasons for three new model variables in 1958 and only two in 1953 is no doubt in order. The explanation is fairly simple. Oliver and Cockshutt did not produce forage harvesters as of spring 1953, but did manufacture them later, only to discontinue production before 1963. Therefore, Oliver and Cockshutt were not included in the 1953, but were included in the 1958 equations. Discontinuation of these forage harvesters, plus one model manufactured by Case from 1955 to 1960, required an additional variable to take this into consideration. On the other hand, none of the 1953 machines were without succeeding models.

The following are the estimating equations including the new models variables as discussed above.

1953 Forage Harvesters

Equation #77

$$\hat{Y}_1 = \underset{(0.714)}{58.854} - \underset{(0.119)}{4.030X_1^{**}} + \underset{(0.821)}{2.593X_2^{**}} + \underset{(0.932)}{1.998X_3^{*}}$$

$$+ \underset{(0.839)}{0.468X_4} + \underset{(0.925)}{4.290X_5^{**}} + \underset{(0.919)}{5.148X_6^{**}} + \underset{(0.805)}{5.005X_7^{**}}$$

$$+ \underset{(0.876)}{0.586X_8} + \underset{(0.818)}{2.455X_9^{**}} - \underset{(0.675)}{1.320X_{10}} - \underset{(0.741)}{1.644X_{11}^{*}}$$

$R^2 = 0.9239$ S.E. = 3.4124

Equation #78

$$\hat{Y}_2 = \underset{(0.758)}{57.614} - \underset{(0.126)}{4.609X_1^{**}} + \underset{(0.871)}{2.339X_2^{**}} + \underset{(0.990)}{2.016X_3^{*}}$$

$$+ \underset{(0.890)}{1.272X_4} + \underset{(0.982)}{4.081X_5^{**}} + \underset{(0.976)}{4.518X_6^{**}} + \underset{(0.855)}{4.896X_7^{**}}$$

$$+ \underset{(0.930)}{1.068X_8} + \underset{(0.868)}{2.617X_9^{**}} - \underset{(0.716)}{1.946X_{10}^{**}} - \underset{(0.786)}{0.169X_{11}}$$

$R^2 = 0.9312$ S.E. = 3.6215

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = Fox

X_6 = Gehl

X_7 = International Harvester

X_8 = New Holland

X_9 = Papec

X_{10} = New Model #1

X_{11} = New Model #2

(Massey Harris is the base for make comparisons.)

Equation #79 $\hat{Y}_1 = 71.089 - 7.567X_1^{**} + 2.660X_2 - 1.654X_3$

$(1.133) \quad (0.162) \quad (1.353) \quad (1.334)$

$- 5.103X_4^{**} - 1.226X_5 + 4.638X_6^{**} + 1.742X_7$

$(1.701) \quad (1.301) \quad (1.374) \quad (1.145)$

$+ 2.334X_8 + 5.138X_9^{**} + 5.316X_{10}^{**} + 6.783X_{11}^{**}$

$(1.374) \quad (1.195) \quad (1.203) \quad (1.826)$

$+ 1.161X_{12} - 1.545X_{13}^{*} - 1.002X_{14} - 2.088X_{15}^{*}$

$(1.233) \quad (0.654) \quad (1.510) \quad (1.023)$

$R^2 = 0.8997$ S.E. = 3.6592

Equation #80 $\hat{Y}_2 = 69.889 - 8.148X_1^{**} + 2.639X_2^{*} - 1.826X_3$

$(1.105) \quad (0.158) \quad (1.320) \quad (1.301)$

$- 5.073X_4^{**} - 1.094X_5 + 4.159X_6^{**} + 1.688X_7^{*}$

$(1.659) \quad (1.269) \quad (1.340) \quad (1.117)$

$- 2.126X_8 + 4.944X_9^{**} + 4.839X_{10}^{**} + 6.247X_{11}^{**}$

$(1.340) \quad (1.166) \quad (1.174) \quad (1.781)$

$+ 1.128X_{12} - 1.589X_{13}^{**} - 0.883X_{14} - 1.689X_{15}$

$(1.202) \quad (0.638) \quad (1.473) \quad (0.998)$

$R^2 = 0.9142$ S.E. = 3.5688

X_1 = Age	X_6 = Ford	X_{11} = Oliver
X_2 = Allis Chalmers	X_7 = Fox	X_{12} = Papec
X_3 = Case	X_8 = Gehl	X_{13} = New Model #1
X_4 = Cockshutt	X_9 = International Harvester	X_{14} = New Model #2
X_5 = John Deere	X_{10} = New Holland	X_{15} = Discontinuation of the line

(Massey Harris is the base for make comparisons.)

Although the total contribution of new models is statistically significant (F-Test) at .05 level for both 1953 Y_1 and 1958 Y_1 equations, the variable has certain disturbing complexities. There seems to be no consistent pattern among the individual new model variables which are significantly different from zero in their effect. In the 1953 equations, new model #2 was significant and new model #1 was not for Y_1 formulation; while the reverse was true of the Y_2 formulation. New model #1 and discontinuation were significantly different from zero in their effect on the 1958 Y_1 equation, but only new model #1 was significant with Y_2.

The largest possible effect could be no more than 4.56 percentage points--a combination of new model #1, new model #2, and discontinuation of a 1958 model--and this did not occur with any sample.

$Y = f$ (Age, + Age^2, Make) --- Curvilinear Model

Even though the R^2's were very high for the linear model of forage harvester values, as compared with tractors and combines, curvilinear equations were also computed. The experience of previous chapters has indicated that a curvilinear model may be useful when the residuals (actual value-estimated value) exhibit a definite pattern of variation from the regression line. The residuals for the linear models of forage harvester values exhibited a pattern which seemed to support the usefulness of computing curvilinear equations.

In order to be consistent with the curvilinear models used for combines and tractors and to avoid the problems involved with new models, the equation $Y = f\ (Age + Age^2, Make)$ was used. Below are the equations for forage harvesters.

1953 Forage Harvester

Equation #81

$$\hat{Y}_1 = \underset{(0.853)}{62.163} - \underset{(0.293)}{5.695X_1^{**}} + \underset{(0.027)}{0.135X_1^{2**}} + \underset{(0.781)}{2.978X_2^{**}}$$

$$+ \underset{(0.781)}{0.736X_3} - \underset{(0.781)}{0.064X_4} + \underset{(0.781)}{3.064X_5^{**}} + \underset{(0.836)}{5.811X_6^{**}}$$

$$+ \underset{(0.781)}{4.914X_7^{**}} - \underset{(0.781)}{0.275X_8} + \underset{(0.781)}{2.253X_9^{**}}$$

$R^2 = 0.9280$ S.E. = 3.3155

Equation #82

$$\hat{Y}_2 = \underset{(0.788)}{63.757} - \underset{(0.267)}{7.911X_1^{**}} + \underset{(0.025)}{0.296X_1^{2**}} + \underset{(0.713)}{2.781X_2^{**}}$$

$$+ \underset{(0.713)}{1.283X_3} + \underset{(0.713)}{0.614X_4} + \underset{(0.713)}{3.150X_5^{**}} + \underset{(0.762)}{5.306X_6^{**}}$$

$$+ \underset{(0.713)}{4.886X_7} + \underset{(0.713)}{0.175X_8} + \underset{(0.713)}{2.194X_9^{**}}$$

$R^2 = 0.9519$ S.E. = 3.0249

X_1 = age

X_1^2 = Age (squared)

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = Fox

X_6 = Gehl

X_7 = International Harvester

X_8 = New Holland

X_9 = Papec

(Massey Harris is the base for make comparisons.)

1958 Forage Harvester

Equation #83

$$\hat{Y}_1 = \underset{(1.198)}{75.683} - \underset{(0.656)}{12.651X_1^{**}} + \underset{(0.110)}{0.845X_1^{2**}} + \underset{(1.207)}{3.349X_2^{**}}$$

$$- \underset{(0.989)}{0.812X_3} - \underset{(1.102)}{5.731X_4^{**}} - \underset{(1.102)}{0.151X_5} + \underset{(1.102)}{6.099X_6^{**}}$$

$$+ \underset{(0.972)}{2.615X_7^{**}} + \underset{(1.102)}{3.794X_8^{**}} + \underset{(1.102)}{4.803X_9^{**}}$$

$$+ \underset{(1.004)}{6.595X_{10}^{**}} + \underset{(1.379)}{6.473X_{11}^{**}} + \underset{(0.995)}{2.367X_{12}^{*}}$$

$R^2 = 0.9122$ S.E. = 3.4136

Equation #84

$$\hat{Y}_2 = \underset{(1.124)}{75.368} - \underset{(0.616)}{14.003X_1^{**}} + \underset{(0.103)}{0.978X_1^{2**}} + \underset{(1.133)}{3.297X_2^{**}}$$

$$- \underset{(0.928)}{0.829X_3} - \underset{(1.035)}{5.309X_4^{**}} - \underset{(1.035)}{0.038X_5} + \underset{(1.035)}{5.612X_6^{**}}$$

$$+ \underset{(0.912)}{2.534X_7^{**}} + \underset{(1.035)}{3.579X_8^{**}} + \underset{(1.035)}{4.587X_9^{**}}$$

$$+ \underset{(0.942)}{6.132X_{10}^{**}} + \underset{(1.294)}{6.222X_{11}^{**}} + \underset{(0.933)}{2.311X_{12}^{**}}$$

$R^2 = 0.9304$ S.E. = 3.2038

X_1 = Age	X_4 = Cockshutt	X_8 = Gehl
X_1^2 = Age (squared)	X_5 = John Deere	X_9 = International Harvester
X_2 = Allis Chalmers	X_6 = Ford	X_{10} = New Holland
X_3 = Case	X_7 = Fox	X_{11} = Oliver
	X_{12} = Papec	

(Massey Harris is the base for make comparisons.

In each case the b value associated with age squared was highly significant (.005 level). The b values for make obtained from the curvilinear equations differ very little from those given by the comparable linear equations. Finally, the R^2's related to the curvilinear equations are somewhat larger than those for the comparable linear equations.

INTERPRETATION

As in earlier chapters, all of the variables tried will be discussed even though they are not among the equations recorded. Inclusion of all the equations would make the study excessively long and contribute little to our understanding of used values.

Age

Age is again a very important and consistent variable. Judging from the R^2's of the Y = f (Age) equations for forage harvesters, combines, and tractors; the used values of forage harvesters were, in general, more closely related to age than the other machines. (See Table 25 on the next page.)

TABLE 25--Multiple determination coefficients (R^2) of the linear regression equations Y = f (Age) for tractors, combines and forage harvesters.[a]

Type of Machine and Model	Multiple Correlation Coeff. Y_1	Y_2
1953 Gasoline Tractors	0.5743	0.7436
1953 Diesel Tractors	0.6508	0.8080
1958 Gasoline Tractors	0.5723	0.6805
1958 Diesel Tractors	0.8193	0.8708
1953 Pull-Type Combines	0.7865	0.8293
1958 Pull-Type Combines	0.8339	0.8756
1953 Self-Propelled Combines	0.7262	0.8161
1958 Self-Propelled Combines	0.6884	0.7489
1953 Forage Harvesters	0.8933	0.9116
1958 Forage Harvesters	0.8131	0.8459

[a]Where Y is the percentage value (based on original cost) of the machine (Y_1) or this value deflated by the appropriate wholesale price index (Y_2).

Even though the simple linear regression equations for age have relatively high R^2's, there is evidence that a curvilinear model might give a better fit. (1) Using the covariance method, the 1953 and 1958 equations are found to be significantly different (at .005 level.) In the previous chapters, this difference was often reconciled by assuming that the "loss-in-value" function was, in general, curvilinear. Therefore one might expect this to be the case with forage harvester values. (2) The average yearly residuals for a 1953 forage harvester equation exhibit a pattern which seems to indicate curvilinearity.

TABLE 26---Average yearly residuals (actual value-estimated value) for forage harvester equation #73.[a]

Machine	Age In Years									
	1	2	3	4	5	6	7	8	9	10
1953 Forage Harvester	2.03	1.15	-1.15	-2.57	-2.92	0.99	1.42	0.72	0.46	0.45

[a]Average residuals were computed from the $Y_1 = f$ (Age,Make) equation, rather than the $Y_1 = f$ (Age) equation as in previous chapters. This of course, does not effect the outcome.

Thus the curvilinear equations, numbers 81-84, may be expected to provide some additional insight into the behavior of used forage harvester values.

Realized Net Farm Income

Forage harvester equations are the first case of the realized net farm income variable being significant at .05 level and having a positive b value throughout. Nonetheless, the variable was omitted from the equations reported in this chapter. There are two reasons for its omission in the final equations. (1) The author could see no valid reason for forage harvester's values being affected by the variable, when it has questionable or no effect on tractors and combines. (Its effect on cornpickers is also questionable, as will be found in Chapter 7.) (2) Although the contribution of the variable weighed against loss of one degree of freedom is significant at .05 level, omitting the variable has little effect on the numerical outcome of estimated values. With the 1953 equations, it was necessary for realized net farm income to change by $770 million to cause a 1.0 percent change in forage harvester values. The greatest difference in the realized net farm income data, for the period studied, was $3,004 million between years 1953 and 1957. This difference would have caused less than four percentage points change in used forage harvester values. The greatest change in used values due to a variation in data for adjacent years was slightly more than 2.5 percentage points. Thus, weighing the contribution of the variable against the uncertanties about it; it was decided that <u>realized net farm income</u> was not of sufficient importance to retain it as a variable in the final equations.

<u>Engine Driven</u>

The results of the <u>engine driven</u> variable were a complete reversal of findings in the combine chapter. <u>Engine driven</u> was not significantly different from zero in its effect on 1953 forage harvesters, but it was significant at .01 for 1958 models--with b values of -1.479 (Y_1) and -1.415 (Y_2). This behavior of the variable casts a shadow on the hypothesis set forth in Chapter IV that engines either deteriorated more rapidly than the rest of the machine, or are an object of greater undertainty as the machine becomes older. The author is faced with the choice of either ignoring the variable, for the time being, or attempting to explain its erratic behavior. The decision was to set the variable aside, as evidenced by its absence in the equations recorded, and examine it again as it applies to balers in Chapter VI.

Make

The object of this section is a thorough examination of the relationships between values of various makes of forage harvesters. (1) Cockshutt (only in 1958 equations) was worth significantly less than all other makes. (2) Case, John Deere, and Massey-Harris were not significantly different (1953 or 1958) and were all valued at significantly less than the majority of the other makes. (3) New Holland was the "changeable" make (like Case for combines and tractors) being valued at significantly less than other makes--excepting Case, John Deere, and Massey-Harris--in the 1953 equations; but significantly more than half the makes in 1958. (4) Gehl was valued significantly higher than all except International Harvester among 1953 models; and was significantly different from Case, John Deere, Cockshutt, and Massey-Harris with 1958 models. (5) *International Harvester*, *Allis Chalmers*, *Fox* and *Papec* are roughly a group, with the first one being valued slightly above the others. (6) *Ford* and *Oliver* (1958 models only) were valued significantly above Fox, Papec, Case, Cockshutt, Allis Chalmers, John Deere, and Massey-Harris; but not significantly different from New Holland.

Again *make* seems to be very useful in explaining variation in values, but is of considerably less value in predicting used values into the future.

Livestock Numbers

Although *livestock numbers* was a significant variable, (the b values were significantly different from zero at the .01 level and its contribution to the equation significant at the .05 level), it was also omitted from the final equations. For the 1953 models, the effect of the variable was reasonable, but numerically rather small. The difference between the greatest and smallest numbers of livestock, within the 1953-1963 period studied, had only a 2.7 percentage point effect on used values.

The effect of the variable on the 1958 models is extremely difficult to interpret. A steady upward trend in livestock numbers exists for the period 1958 through 1963. This results in livestock numbers being highly intercorrelated with age---0.9825. As a result, the constant ("a" value) becomes a large negative number and the numerical size of the b value for age is substantially increased. With respect to the 1953 equation, the 1958 equation overemphasizes the upward effect of increases in livestock numbers and the downward effect of age. The best that may be done is to conclude that livestock numbers probably has a small effect on the value of used forage harvesters.

New Models

New Models, as noted earlier were very erratic in their pattern of effect on used forage harvester values. The outcome of the variable, as it stands, does not lend itself to any underestandable generalization of the effect of new models on the value of their predecessors. Discussion of some of the problems with this variable can be found in earlier chapters and will not be repeated here.

Row Crop--Cutterbar--Pickup

There was no significant difference between the values of forage harvesters equipped with the alternative attachments.

Either the attachments had similar "loss-in-value" characteristics or were an insignificant part of the machine's value.

Inflation

Deflation of the dependent variable (by Bureau of Labor Statistics wholesale price index for forage harvesters--indicating an average yearly increase in prices of 3.079) resulted in an increase in the b value of age of from .54 to .58 percentage points. Surprisingly, the increase was slightly larger with 1958 models than with 1953 models, quite the reverse of earlier experience. The improved fit of the equations using the deflated (or constant dollar) values indicates that inflation has an important effect on used forage harvester values.

Curvilinear Model

The curvilinear model (age variable squared) made a significant contribution to explaining used forage harvester values. The b value for the variable age squared was significant at .01 level.

Its significance established, it would be worthwhile to contrast the linear and curvilinear findings. The outcome of similar equations includingage and make variables is given in Table 27.

TABLE 27---Yearly decline in value (as a percent of original cost) and estimated used value (as a percent of original cost) for forage harvesters, computed from equations # 73,75,81 and 83.[a]

Model and Method	Years of Age 1	2	3	4	5	6	7	8	9	10
				Yearly Decline In Value						
Eqn. # 81 1953 Curvilinear	43.4	5.3	5.2	4.8	4.5	4.2	3.9	3.7	3.4	3.1
Eqn. # 73 1953 Linear	44.8	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Eqn. # 83 1958 Curvilinear	36.1	10.1	8.4	6.7	5.0					
Eqn. # 75 1958 Linear	37.2	7.7	7.7	7.7	7.7					
				Estimated Used Value						
Eqn. # 81 1953 Curvilinear	56.6	51.3	46.3	41.5	37.1	32.9	28.9	25.2	21.8	18.7
Eqn. # 73 1953 Linear	55.2	50.9	46.6	42.3	38.0	33.8	29.4	25.2	20.9	16.6
Eqn. # 83 1958 Curvilinear	63.9	53.8	45.3	38.6	33.6					
Eqn. # 75 1958 Linear	62.1	54.4	46.7	38.9	31.2					

[a] The effect of the make variables for these equations is not included in the table.

Even though the curvilinear model provided a considerable improvement in fit, there remains evidence of unexplained curvilinearity in the average residuals. This is no doubt due to the mathematical restrictions of the squared term. (Table 28)

Note that along with the familiar pattern of variation, there is a slight overestimation of the values for the last two years.

In general, the particular curvilinear model used here seems to be a closer approximation of the "loss-in-value" function, but does not completely eliminate the pattern of variation from the regression estimates found in the linear models.

Summary

Used forage harvester valuess are closely related to the age of the machine, even more closely than used tractor and combine values. In fact, age was capable of explaining 81% to 89% of the variation in used forage harvester values, as given in current dollars, and 84% to 91%, as given in constant dollars.

The used values for forage harvesters were slightly effected by both realized net farm income and numbers of livestock on farms. In both cases the relationship was significant

TABLE 28---Average yearly residuals (actual value-estimated value) for equation #81, curvilinear model for 1953 forage harvesters.

	Years of Age									
Machine	1	2	3	4	5	6	7	8	9	10
1953 Forage Harvester	0.75	0.72	-0.80	-1.79	-1.97	2.00	1.94	0.54	-0.41	-0.86

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and positive (for increases in the data), but numerically rather small.

Once again, make was very useful in explaining used values, but should not be expected to have much value for predictive purposes.

Deflation of used values indicates that forage harvesters have 0.54 to 0.58 percentage points greater "loss-in-value" in real terms, than in dollar terms. Removal of inflation also seems to substantially improve the explanatory ability of the other variables.

The engine driven machines seemed to be valued at significantly less among the 1958 models, but not with the 1953 models.

In general, the "loss-in-value" function appears to be curvilinear. The estimating equations (both linear and curvilinear) indicate that the first years "loss-in-value" should be expected to be around 40.0% (± 5.0% would include all of the estimates in Table 27.) One should probably expect ten year old forage harvesters to be worth about 18.0% of their original value. Good linear approximations of yearly "loss-in-values", due to age, seem to be about 4.3% from the second through the tenth year. Curvilinear estimates of yearly decline in value ranges from as high as 10.1% (second year for 1958 models) to as low as 3.1% (tenth year for 1953 models.)

ANALYSIS OF USED BALER VALUES

Chapter VI

INTRODUCTION

This analysis generally follows the, by now, familiar form used with earlier chapters. 1953 and 1958 baler values are examined over the periods 1953-1963, and 1958-1963 respectively. Minneapolis Moline is again the "base-make" for the make variables, and only one previously unexplained variable will be defined in this chapter.

VARIABLE

Twine-Wire Tie

The argument for including the type of material used to bind the bales is not unlike the argument for separating pull-type and self-propelled combines, gasoline and diesel tractors; and even more akin to the use of the row crop, cutterbar, and pickup variables with forage harvesters. Twine and wire-tie balers are technically different, despite their obvious substitutability for field operations. It is entirely possible that farmers prefer one over the other, and that this would be reflected in their comparative used values.

The structure of the variable covering this possibility is a single dummy variable labeled twine. If the machine is a twine tie, a one is entered; a zero indicates a wire tie baler. In general, the relevant regression equation measures the value of used twine-tie balers against wire-tie balers.

ESTIMATING EQUATIONS

Y = f (Age)

The following regression equations estimate used baler values using the single variable age.

1953 Balers

Equation #85 $\hat{Y}_1 = 65.051 - 5.171X_1$**

$(1.470) \quad (0.244)$

$R^2 = 0.7992$ S.E. = 7.3532

Equation #86 $\hat{Y}_2 = 65.070 - 5.497X_1$**

$(1.386) \quad (0.230)$

$R^2 = 0.8349$ S.E. = 6.9344

1958 Balers

Equation #87 $\hat{Y}_1 = 73.380 - 8.271X_1$**

$(0.903) \quad (0.304)$

$R^2 = 0.8046$ S.E. = 5.2956

Equation #88 $\hat{Y}_2 = 71.560 - 8.785X_1$**

$(0.881) \quad (0.297)$

$R^2 = 0.8297$ S.E. = 5.1710

As with the other machines examined thus far, there is no question of the significance and importance of age as a variable (80% of the variation in baler values can be attributed to age and the b value of the age variable is significant at .001).

At this point, it is no surprise to find that b values for <u>age</u> are larger in the 1958 equations than in the 1953 equations; or that Y_2 formulations result in a better "fit" of these simple linear equations.

<u>Y = f (Age, Make)</u>

The following equations include a make variable for each of the companies manufacturing balers in 1953 and 1958, except Minneapolis Moline, which is the basis of comparison.

1953 Balers

$$\text{Equation \#89}\quad \hat{Y}_1 = \underset{(2.125)}{62.026} - \underset{(0.193)}{5.139X_1}^{**} + \underset{(2.296)}{11.823X_2}^{**} - \underset{(2.674)}{6.036X_3}^{*} + \underset{(2.296)}{1.406X_4} + \underset{(2.253)}{3.235X_5} + \underset{(2.602)}{2.610X_6} + \underset{(2.253)}{3.650X_7} - \underset{(2.602)}{1.930X_8}$$

$R^2 = 0.8821$ S.E. = 5.8176

$$\text{Equation \#90}\quad \hat{Y}_2 = \underset{(2.029)}{61.950} - \underset{(0.185)}{5.469X_1}^{**} + \underset{(2.192)}{11.210X_2}^{**} - \underset{(2.553)}{5.297X_3}^{*} + \underset{(2.192)}{1.560X_4} + \underset{(2.151)}{3.245X_5} + \underset{(2.484)}{3.090X_6} + \underset{(2.151)}{3.850X_7} - \underset{(2.484)}{1.350X_8}$$

$R^2 = 0.9007$ S.E. - 5.5536

X_1 = Age

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = International Harvester

X_6 = Massey Harris

X_7 = New Holland

X_8 = Oliver

(Minneapolis Moline is the base for make comparisons.)

1958 Balers

Equation #91 $\hat{Y}_1 = 74.592 - 8.091X_1{}^{**} + 2.096X_2 - 6.312X_3{}^{**}$
$(2.281) \quad (0.275) \quad (2.713) \quad (2.322)$

$- 1.050X_4 - 5.791X_5{}^{*} + 2.867X_6 - 1.945X_7$
$(2.340) \quad (2.713) \quad (2.569) \quad (2.289)$

$- 1.554X_8 + 0.184X_9 - 2.382X_{10}$
$(2.439) \quad (2.277) \quad (2.421)$

$R^2 = 0.8503$ S.E. = 4.7555

Equation #92 $\hat{Y}_2 = 72.805 - 8.615X_1{}^{**} + 1.884X_2 - 6.141X_3{}^{**}$
$(2.259) \quad (0.272) \quad (2.687) \quad (2.300)$

$- 1.007X_4 - 5.353X_5{}^{*} + 2.095X_6 - 1.844X_7$
$(2.318) \quad (2.687) \quad (2.545) \quad (2.267)$

$- 1.553X_8 + 0.099X_9 - 2.364X_{10}$
$(2.415) \quad (2.254) \quad (2.397)$

$R^2 = 0.8658$ S.E. = 4.7099

X_1 = age
X_2 = Allis Chalmers
X_3 = Case
X_4 = John Deere
X_5 = Ferguson
X_6 = Ford
X_7 = International Harvester
X_8 = Massey Harris
X_9 = New Holland
X_{10} = Oliver

(Minneapolis Moline is the base for make comparison.)

Since only the b values for two of the several makes in each equation--Allis Chalmers and Case among 1953 models, and Case and Ferguson among 1958 models--were significantly different from zero; there is considerable reason to question the usefulness of the <u>make</u> variables as a group. Application of an F-test on <u>make</u> (in aggregate) resolves this uncertainty by indicating that the contribution of these variables was significant at the .005 level for both 1953 and 1958 equations.

An examination of the comparative valuations of makes will be undertaken later in the chapter.

<u>Y = f (Age, Make, Engine Driven)</u>

As part of the sample of balers was equipped with an independent source of power (for operating the baling mechanism) and others were dependent upon the tractor (PTO), <u>engine driven</u> was included as a dummy variable. (The rationale for inclusion of <u>engine driven</u> may be found in the variables section in Chapter IV.)

1953 Balers

Equation #93 $\hat{Y}_1 = 68.523 - 5.200X_1{}^{**} + 8.371X_2{}^{**} - 6.060X_3{}^{*}$

(2.498) (0.180) (2.282) (2.483)

$- 2.045X_4 + 0.153X_5 + 2.610X_6 + 3.650X_7$

(2.282) (2.215) (2.415) (2.092)

$- 1.930X_8 - 6.164X_9{}^{**}$

(2.415) (1.454)

$R^2 = 0.8993$ S.E. = 5.4012

Equation #94 $\hat{Y}_2 = 68.312 - 5.527X_1{}^{**} + 7.927X_2{}^{**} - 5.319X_3{}^{*}$

(2.386) (0.172) (2.180) (2.371)

$- 1.723X_4 + 0.313X_5 + 3.090X_6 + 3.850X_7$

(2.180) (2.115) (2.307) (1.998)

$- 1.350X_8 - 5.865X_9{}^{**}$

(2.307) (1.389)

$R^2 = 0.9151$ S.E. = 5.1590

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = International Harvester

X_6 = Massey Harris

X_7 = New Holland

X_8 = Oliver

X_9 = Engine Driven

(Minneapolis Moline is the base for make comparison)

1958 Balers

Equation #95 $\hat{Y}_1 = 75.108 - 8.263X_1^{**} + 2.486X_2 - 5.893X_3^{**}$
$(2.297) \quad (0.296) \quad (2.714) \quad (2.329)$

$- 0.660X_4 - 5.402X_5^{*} + 3.434X_6 - 1.555X_7$
$(2.345) \quad (2.714) \quad (2.586) \quad (2.294)$

$- 1.164X_8 + 0.629X_9 - 1.863X_{10} - 1.211X_{11}$
$(2.442) \quad (2.286) \quad (2.345) \quad (0.790)$

$R^2 = 0.8524$ S.E. = 4.7368

Equation #96 $\hat{Y}_2 = 73.350 - 8.797X_1^{**} + 2.296X_2 - 5.698X_3^{**}$
$(2.273) \quad (0.293) \quad (2.686) \quad (2.305)$

$- 0.596X_4 - 4.942X_5 + 2.694X_6 - 1.432X_7$
$(2.320) \quad (2.686) \quad (2.559) \quad (2.270)$

$- 1.142X_8 + 0.569X_9 - 1.816X_{10} - 1.279X_{11}$
$(2.417) \quad (2.262) \quad (2.409) \quad (0.781)$

$R^2 = 0.8679$ S.E. = 4.6869

X_1 = age
X_2 = Allis Chalmers
X_3 = Case
X_4 = John Deere
X_5 = Ferguson
X_6 = Ford
X_7 = International Harvester
X_8 = Massey Harris
X_9 = New Holland
X_{10} = Oliver
X_{11} = Engine Driven

(Minneapolis Moline is the base for make comparisons.)

The b values for engine driven were significantly different from zero in the 1953 baler equations, but not with 1958 equations. This is exactly the result found when engine driven was applied to pull-type combines, but contrary to the experience with forage harvesters.

It should be noted that the numerical value of both the constant ("a" value")and b value were somewhat changed when engine driven was added to the equations. A more thorough examination of the effect of these numerical differences will be undertaken later in the chapter.

Y = f (Age, Make, Engine Driven, New Model)

The following equations attempt to determine the effect of new models on the value of the older models they replace. Recall that the number of new model variables necessary is equal to the largest number of replacement models for any sample, plus a discontinuation variable where it is applicable.

1953 Baler

Equation #97
$$\hat{Y}_1 = 62.822 - \underset{(0.234)}{4.599X_1^{**}} + \underset{(2.192)}{9.409X_2^{**}} + \underset{(3.211)}{2.559X_3}$$
$$(2.411)$$
$$+ \underset{(2.104)}{1.282X_4} + \underset{(2.297)}{7.101X_5^{**}} + \underset{(2.121)}{2.400X_6} + \underset{(2.132)}{10.071X_7^{**}}$$
$$+ \underset{(2.386)}{0.909X_8} - \underset{(1.433)}{2.504X_9} - \underset{(1.628)}{2.105X_{10}} - \underset{(1.741)}{3.994X_{11}^{*}}$$
$$- \underset{(2.862)}{7.541X_{12}^{**}} + \underset{(3.884)}{0.589X_{13}} - \underset{(2.133)}{11.310X_{14}^{**}}$$

$R^2 = 0.9265$ S.E. = 4.7295

Equation #98
$$\hat{Y}_2 = 63.038 - \underset{(0.226)}{4.950X_1^{**}} + \underset{(2.116)}{8.562X_2^{**}} + \underset{(3.100)}{2.280X_3}$$
$$(2.328)$$
$$+ \underset{(2.031)}{1.401X_4} + \underset{(2.218)}{6.808X_5^{**}} + \underset{(2.048)}{2.831X_6} + \underset{(2.058)}{9.788X_7^{**}}$$
$$+ \underset{(2.304)}{1.403X_8} - \underset{(1.383)}{2.387X_9} - \underset{(1.572)}{2.589X_{10}} - \underset{(1.681)}{3.436X_{11}^{*}}$$
$$- \underset{(2.762)}{6.557X_{12}^{*}} + \underset{(3.740)}{1.071X_{13}} - \underset{(2.059)}{10.981X_{14}^{**}}$$

$R^2 = 0.9367$ S.E. = 4.5656

X_1 = age; X_5 = International Harvester; X_9 = Engine Driven

X_2 = Allis Chalmers; X_6 = Massey Harris; X_{10} = New Model #1

X_3 = Case; X_7 = New Holland; X_{11} = New Model #2

X_4 = John Deere; X_8 = Oliver; X_{12} = New Model #3

X_{13} = New Model #4; X_{14} = Discontinuation of line

(Minneapolis Moline is the base for make comparisons.)

1958 Balers

Equation #99
$$\hat{Y}_1 = \underset{(2.140)}{75.656} - \underset{(0.300)}{8.445X_1^{**}} + \underset{(2.490)}{2.402X_2} - \underset{(2.256)}{3.380X_3}$$
$$- \underset{(2.151)}{0.744X_4} + \underset{(3.012)}{0.208X_5} + \underset{(2.409)}{3.975X_6} - \underset{(2.219)}{1.161X_7}$$
$$- \underset{(2.285)}{0.159X_8} + \underset{(2.227)}{0.245X_9} - \underset{(2.306)}{0.992X_{10}} - \underset{(0.726)}{1.170X_{11}}$$
$$- \underset{(0.869)}{1.459X_{12}} + \underset{(1.607)}{7.064X_{13}^{**}} - \underset{(2.306)}{1.653X_{14}^{**}}$$

$R^2 = 0.8781$ S.E. = 4.3432

Equation #100
$$\hat{Y}_2 = \underset{(2.120)}{74.177} - \underset{(0.297)}{9.072X_1^{**}} + \underset{(2.466)}{2.163X_2} - \underset{(2.235)}{3.716X_3}$$
$$- \underset{(2.131)}{0.729X_4} - \underset{(2.984)}{0.581X_5} + \underset{(2.386)}{3.055X_6} - \underset{(2.198)}{1.338X_7}$$
$$- \underset{(2.263)}{0.665X_8} - \underset{(2.206)}{0.258X_9} - \underset{(2.284)}{1.145X_{10}} - \underset{(0.719)}{1.199X_{11}}$$
$$- \underset{(0.861)}{1.220X_{12}} + \underset{(1.592)}{7.739X_{13}^{**}} - \underset{(1.637)}{4.494X_{14}^{**}}$$

$R^2 = 0.8906$ S.E. = 4.3022

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = Ferguson

X_6 = Ford

X_7 = International Harvester

X_8 = Massey Harris

X_9 = New Holland

X_{10} = Oliver

X_{11} = Engine Driven

X_{12} = New Model #1

X_{13} = New Model #2

X_{14} = Discontinuation of the line

(Minneapolis Moline is the base for make comparison)

New models, again with balers, yields mixed results. The outcome of the variable for 1953 equations could certainly be used to support the rationale for its inclusion, for the 1958 equations it could not. The results in 1953 are believeable --each succeeding model causes a greater decrease in value of the original model, until another new model is no longer important--but the outcome of new models in 1958 equations is most unrealistic.

If the b values (for new models) in the 1958 equations are added, the sum is positive for the Y_2 equations (2.025) and an extremely small negatiave number (-0.089) for the Y_1 equation. It is fairly clear that the large positive b values for new model #2 were measuring some other effect.

Even in 1953 equations, where new models supports its rationale, the addition of this variable caused a considerable reshuffling of the t values for other variables, especially make. This reshuffling of the make variables, however, should be expected. In conjunction with new models, make explains something entirely different than before. Conceptually, it estimated the relative value of the makes if new models had not been introduced.

<u>Curvilinear Model--Y - f (Age + Age^2, Make, Engine Driven)</u>

Upon the expectation that a curvilinear model would more closely approximate the unknown "loss-in-value" function than a linear model, the curvilinear equations below were computed. Because of uncertainty about the new models variable and the desire to conform to the curvilinear models reported in earlier chapters, the simpler equation of Y = f (Age + Age^2, Make, Engine Driven) was used.

1953 Balers

Equation #101 $\hat{Y}_1 = \underset{(2.793)}{71.624} - \underset{(0.764)}{6.927X_1^{**}} + \underset{(0.069)}{0.159X_1^{2*}} + \underset{(2.240)}{8.651X_2^{**}}$

$- \underset{(2.433)}{5.977X_3^{*}} - \underset{(2.240)}{1.766X_4} + \underset{(2.171)}{0.265X_5} + \underset{(2.367)}{2.610X_6}$

$+ \underset{(2.050)}{3.650X_7} - \underset{(2.367)}{1.930X_8} - \underset{(1.428)}{5.940X_9^{**}}$

$R^2 = 0.9042$ S.E. = 5.2931

Equation #102 $\hat{Y}_2 = \underset{(2.596)}{72.351} - \underset{(0.711)}{7.863X_1^{**}} + \underset{(0.064)}{0.216X_1^{2**}} + \underset{(2.082)}{8.307X_2^{**}}$

$- \underset{(2.262)}{5.207X_3^{*}} - \underset{(2.082)}{1.343X_4} + \underset{(2.018)}{0.465X_5} + \underset{(2.201)}{3.090X_6}$

$+ \underset{(1.906)}{3.850X_7^{*}} - \underset{(2.201)}{1.350X_8} - \underset{(1.328)}{5.561X_9^{**}}$

$R^2 = 0.9235$ S.E. = 4.9207

X_1 = age

X_1^2 = Age (squared)

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = International Harvester

X_6 = Massey Harris

X_7 = New Holland

X_8 = Oliver

X_9 = Engine Driven

(Minneapolis Moline is the base for make comparison)

1958 Balers

Equation #103
$$\hat{Y}_1 = \underset{(2.486)}{81.515} - \underset{(1.196)}{14.195X_1}^{**} + \underset{(0.203)}{1.035X_1^2}^{**} + \underset{(2.534)}{2.459X_2}$$
$$- \underset{(2.176)}{5.497X_3}^{**} - \underset{(2.189)}{0.687X_4} - \underset{(2.534)}{5.429X_5}^{*} + \underset{(2.414)}{3.394X_6}$$
$$- \underset{(2.142)}{1.582X_7} - \underset{(2.280)}{1.191X_8} + \underset{(2.135)}{0.598X_9} - \underset{(2.274)}{1.682X_{10}}$$
$$- \underset{(0.750)}{0.513X_{11}}$$

$R^2 = 0.8720$ S.E. = 4.4228

Equation #104
$$\hat{Y}_2 = \underset{(2.348)}{81.306} - \underset{(1.130)}{16.163X_1}^{**} + \underset{(0.192)}{1.286X_1^2}^{**} + \underset{(2.394)}{2.262X_2}$$
$$- \underset{(2.056)}{5.207X_3}^{**} - \underset{(2.068)}{0.630X_4} - \underset{(2.394)}{4.975X_5}^{*} + \underset{(2.281)}{2.645X_6}$$
$$- \underset{(2.024)}{1.466X_7} - \underset{(2.154)}{1.175X_8} + \underset{(2.017)}{0.531X_9} - \underset{(2.148)}{1.592X_{10}}$$
$$- \underset{(0.708)}{0.412X_{11}}$$

$R^2 = 0.8956$ S.E. = 4.1783

X_1 = age	X_4 = John Deere	X_8 = Massey Harris
X_1^2 = age (squared)	X_5 = Ferguson	X_9 = New Holland
X_2 = Allis Chalmers	X_6 = Ford	X_{10} = Oliver
X_3 = Case	X_7 = International Harvester	X_{11} = Engine Driven

(Minneapolis Moline is the base for make compariosns.)

In each case the b value for age was significant at .01, and the b value of age-squared at .02 or less. The coefficients for age were, of course, numerically (significantly for all but 1953 Y_1) quite different from the comparable linear model, while the other variables (Make, Engine Driven) were changed very little.

The curvilinear model is a significant improvement over the comparable linear models, as measured by the F-test. These F-tests indicated that the contribution of the age-squared variables was significant at the .025 level for the 1953 Y_1 equation and.005 level for the 1958 Y_1 equation.

INTERPRETATION

The following employs comparisons and statistical tests in order to expand upon the information given in the equations presented.

Age

There is no question of the importance or significance of age in explaining used baler values. Further, the constancy of b values for age, throughout each series of linear equations (1953 Y_1, 1953 Y_2, 1958Y_1, and 1958 Y_2,) indicates that other variables were in general, complementary. The single qualification was that the 1953 equations for Y=f (Age, Make, Engine Driven, New Models) exhibited significantly different values for age from those in Y=f (Age, Make, Engine Driven); indicating that new models may be a partial substitute for age.

1953 and 1958 equations for age were once again significantly different, suggesting that a curvilinear model might be useful. (There also seems to be some indication of a trend toward more rapid "loss-in-value" for balers in later years.) Computation of the average yearly residuals uncovers the familiar pattern of variation from the regression line, supporting the assumption of curvilinearity (see Table 29 on the next page.)

Realized Net Farm Income

The RNFI variable was not included in the final set of equations computed for used baler values. It was omitted because of the erratic results obtained when the variable was applied to the used values of tractors, combines,---and as will be discovered in the next chapter, cornpickers. Including it would have involved devising an explanation of the variable's behavior over all the machines studied. On the other hand little is lost by omitting the variable. Although it's b values were significantly different from zero at the .01 level, the effect of RNFI on used values was relatively small. The total variation in used baler values attributable to RNFI,

TABLE 29---Average yearly residuals (actual used value-estimated used value) for 1953 and 1958 balers estimated from the linear regression equations #85 and 87.

Equation	Years of Age 1	2	3	4	5	6	7	8	9	10
	Percentage Points									
1953 $Y_1 = f$ (Age)	5.36	-2.59	-2.13	-2.27	-0.79	0.20	0.28	1.25	-0.47	0.95
1958 $Y_1 = f$ (Age)	2.63	-0.12	-2.38	-1.48	4.25					

within the 1953-1963 time span, was approximately 5.41 percentage points. (This represents .00180 times #3004 million, which is the average b value for RNFI times the difference between the largest--1953 and smallest --1957--incomes during the period.)

Make

The relationship between makes was reasonably simple, and consistent, for balers. (1) International-Harvester, John Deere, Minneaspolis Moline, New Holland and Massey Harris were not significantly different from each other for either the 1953 or 1958 models. (2) Case and Ferguson (1958 only) were the lowest valued makes. They were valued at significantly less than every make except Oliver. (3) Oliver was valued at significantly less than Allis Chalmers, New Holland, and International Harvester for 1953 models; and significantly less than Ford and Allis Chalmers for 1958 models. (4) Ford (1958 only) and Allis Chalmers (Roto Baler) appeared to have been more valuable than other makes. The 1953 models of Allis Chalmers exceeded the used values of all other makes by a significant amount. The 1958 equations gave Ford and Allis Chalmers as valued significantly above Case, Ferguson, International Harvester, John Deere, and Massey Harris.

Comparison of baler equations with and without the make variables--Y = f (Age), and Y = f (Age, Make) -- provided additional evidence that the effect of <u>make</u> might be conceptualized as varying with time. That is, the difference in value between a highly valued baler and a less-valued baler will increase as the machines grow older. Specifically, the evidence is a comparison of the standard error of estimate related to each year of age for the equations in question.

As illustrated in the table below, the inclusion of make variables was more effective in reducing the "error of estimate" for years 1959 through 1963 than for 1954 through 1958. This may logically be used to support the concept that the effect of <u>make</u> varied as a function of time.

The formulation of the <u>make</u> variables does not permit them to vary with age. Consequently, coefficients for <u>make</u> variables represent the best estimate of the effect of given makes throughout the period studied. If makes were of greater importance in the later years, the reduction of the "error of estimate" should be the greatest, in general, where an estimate of the differential values of makes is most necessary for the explanation of used values. In addition, there should be a point in time where the coefficients for <u>make</u> (constants over time)are closest to the actual differences between makes.

TABLE 30---Standard error of estimate related to each year of age computed from regression equations for Y_1 = f (Age) and Y_1 = f (Age, Make).

	Years of Age									
Equation	1	2	3	4	5	6	7	8	9	10
	"Error of Estimate" (in percentage points)									
(1) Y=f (Age)-- Eqn. #1	8.70	11.70	4.87	4.71	4.50	8.33	7.95	6.08	6.92	5.47
(2) Y=f (Age, Make)-- Eqn. # 5	8.35	10.72	3.74	3.92	3.26	4.38	4.04	3.17	4.55	3.88
% (2) / (1)	95.9	91.6	76.7	83.2	72.4	52.5	50.8	52.1	65.7	70.9

This seems to occur in 1960, but would not occur at all if the differences in values for makes were really a constant over time.

There seems to be a reasonable explanation for the effect of make varying as a function of time. Certainly time would be required for dissemination of information about the various makes.

Engine Driven

The 1953 equations indicated that there was a significant difference in value between engine driven and comparable PTO balers. The engine driven units appear to be worth about 6.0 points less in percentage value than their PTO counterparts. However,this does not seem to be the case with the 1958 models. The significant effect of engine driven for 1953 equations and lack of significance for 1958 seems to support the hypothesis advanced to explain this same condition for pull-type combines. The hypothesis was that engines either deteriorate more rapidly than the rest of the used machines, or are the object of greater uncertainty to the potential buyer as the machine becomes older. Since the introduction of engine driven alters the b values for make as given in the equation without the variable, it may be difficult to see the relationship between the two equations.

The author found the following table useful in examining the relationship between <u>engine driven</u> and <u>make</u> variables.

TABLE 31---Estimated percentage values (used value/new cost) for each make of 1953 balers at six years of age (1959), as estimated by regression equations for Y = f (Age, Make) and Y = f (Age, Make, Engine Driven.)

Make	Y=f (Age,Make,Engine Driven) Engine Driven	Y=f (Age,Make,Engine Driven) PTO	Y=f (Age,Make)
Allis Chalmers	39.53%	45.69%	43.21%
Case	25.10	-----	25.35
John Deere	29.11	35.27	32.28
International Harvester	31.31	37.45	34.63
Massey Harris	33.77	-----	34.00
New Holland	34.81	-----	35.04
Oliver	29.23	-----	29.46
Minneapolis Moline	31.16	-----	31.39

Livestock Numbers

Since balers, like forage harvesters, are tied to the livestock industry; it seemed only reasonable to try <u>livestock numbers</u> as a variable. It was not significant in 1953 model baler equations. With 1958 models it was significantly different from zero at .01 level, but its use caused the constant ("a" value) to become a very large negative number. In addition, the b value for age is nearly doubled. This situation is undoubtedly the result of a very high intercorrelation between age and the 1959-1963 data for livestock numbers, 0.98608.

There is probably good reason to believe that used baler (and forage harvester) values are little affected by marginal changes in livestock numbers.

New Models

The results of the new models variable for 1953 equations are believable---each succeeding model causes a greater decrease in value of the original model, until another new model is no longer important---but the outcome of the variable was unrealistic for the 1958 equations. For the 1958 Y_2 equation the sum of b values for new models was positive (2.025) and only slightly negative (-0.089) for the Y_1 equation. (See Chapter III and IV for discussions of the possible problems involved with this variable.)

Twine, Wire-Tie

The variable twine, used to measure difference in value between wire and twine-tie balers, was not included in the final equations. The b values were significant and positive for all the 1958 equations. The b values for the 1953 equations were not significant unless new models was also a variable. Then it was significant and negative. Apparently, some of the influence of this variable was associated with new models. In general, the variable seems to give no clear-cut answer regarding any difference between the values of twine-tie and wire-tie balers.

Inflation

Inflation of new baler prices (Bureau of Labor Statistics wholesale price indices) was approximately 1.7% per year from 1953 to 1963 and approximately 2.5% per year for 1958 to 1963. Quite logically, the effect of inflation on the b values for age was greater for 1958 equations than for 1953 equations--an average numerical increase of 0.55 and 0.33 percentage points respectively. A yearly change in b value of 0.33 seems relatively small, but at ten years of age inflation accounted for about 25% of the machines's value.

The only method of measuring the contribution of inflation ---an F-test is not applicable as two separate equations are involved--is to observe the amount of variance which is explained by the variables in the Y_2 equations as compared to those same variables for Y_1 equations. As before, comparable R^2's indicate that a substantially better "fit" is obtained from equations computed for the Y_2---"constant dollar" -- formulation than for the Y_1--"current dollar"--formulation of the dependent variables. On this basis, one can assume that inflation makes a worthwhile contribution toward understanding used baler values.

Curvilinear Model

The curvilinear model was a significant improvement in fit over the linear model, at the .05 level, as measured by F-tests. A comparison of the used value estimates of the two models, Y = f (Age, Make, Engine Driven) and Y = f (Age + Age^2, Make, Engine Driven)--linear and curvilinear respectively--is given in the table on the following page.

As compared to the better estimates provided by the curvilinear model, the linear model is shown to have overestimated the initial drop in value, underestimated the next few years "loss-in-value" and overestimated the later years. Even with improvement offered by the curvilinear model, a pattern of variance from the regression curve still seems to exist. The average residuals in Table 33 illustrate this point.

TABLE 32---Estimates of the percentage value, (used value/ new cost) and yearly "loss-in-value" for 1953 and 1958 model balers, computed from equations # 97, 99, 101, and 103.[a]

Model	1	2	3	4	5	6	7	8	9	10
					Percentage Value					
1953										
Curvilinear--Eqn. #101	64.87	58.40	52.30	46.50	41.02	35.84	31.00	26.47	22.24	18.35
Linear---Eqn. #97	63.32	58.12	52.90	47.72	42.52	37.32	32.12	26.92	21.72	16.52
1958										
Curvilinear--Eqn. #103	68.36	57.26	48.24	41.28	36.40	-----	-----	-----	-----	-----
Linear--Eqn. #99	66.85	58.59	50.33	42.07	33.81	-----	-----	-----	-----	-----
					-Yearly "Loss-In-Value"					
1953										
Curvilinear---Eqn.#101	35.13	6.44	6.13	5.80	5.48	5.18	4.84	4.53	4.23	3.89
Linear---Eqn. # 97	36.68	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
1958										
Curvilinear--Eqn. #103	31.64	11.10	9.02	6.96	4.88	----	----	----	----	----
Linear---Eqn. #99	33.15	8.26	8.26	8.26	8.26	----	----	----	----	----

[a]The effect of make and engine driven have not been included in the figures above.

TABLE 33--Average yearly residuals (actual value - estimated value) for used baler value estimates computed from the regression equation #101---Curvilinear Model.

	Age In Years									
Equation	1	2	3	4	5	6	7	8	9	10
	(Percentage Points)									
Eqn. #101---Curvilinear Model	3.47	-3.22	-1.77	-1.12	0.49	1.47	1.24	1.56	-2.11	-0.65

The information in the table indicates that the residuals of the model tend to have a pattern similiar to the linear model, except the last two years values were overestimated.

Summary

As expected, age was the most important variable. Alone it could explain 80% or more of the variation in used baler values.

Realized Net Farm Income seemed to have a small, but significant, effect on baler values. The new models variable was not very useful as its results were quite erratic when applied to the 1958 models. The sum of the new models variables in one case was even positive. This result, of course, was unacceptable in terms of the variables's rationale.

Make was very helpful in explaining used baler values. The addition of make, with the linear model, increases R^2s from 0.7992 to 0.8821 and 0.8046 to 0.8503 for 1953 and 1958 models respectively. Once again, the effect of make seems to vary as a function of time.

As with combines, engine driven seemed to be a significant variable over the ten year period, but not for the shorter span. The average effect of engine driven over the longer period was for these balers to be worth 6.0 points less in percentage value than the PTO models.

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Inflation seemed to play an important part in used baler values. The "loss-in-value" in "real" terms appears to have been about .33 to .55 percentage points (in terms of the original value) per year faster than in terms of "current dollars."

The "loss-in-value" was in general curvilinear. A curvilinear model (using both linear and squared terms to represent the effect of age) provided a somewhat better "fit" than the linear models.

The following are estimates of what might be expected for balers in terms of first year value, tenth year value, and rate of "loss-in-value". (These figures are all based on "current dollar" values.) Estimates of first year values from the simplest equations were 59.9% (1953 models) and 65.1% (1958 models). Recall that the linear model tends to underestimate the first year's used values. (The average residual indicates that this underestimation for the 1953 equation was about 5.4%). The most complete linear model without involving the effect of makes or engine driven, gives the value of a one year old baler as 63.3% for 1953 models and 66.9% for 1958. (This would in essence be the expected value of a Minneapolis Moline PTO baler at one year of age.) The curvilinear model for the same variables gives 64.9% in 1953 equations and 68.4%

in 1958 equations. These estimates for 1953 models also appear to be somewhat low (see residuals in Table 33.)

The best linear estimate of yearly "loss-in-value" seems to be 5.2% over the ten year period. The curvilinear equations for the same time span indicate yearly declines in value of from 6.44% down to 3.89%. Comparable values are higher for both linear and curvilinear equations for the 1958 models.

The simplest linear equation assigns a value of 13.3% to a ten year old baler. The most complete curvilinear equation gives 18.8%. Examination of the average residuals of each indicates that the simple linear equation probably underestimates value in the tenth year, while the curvilinear equation doubtless overestimates it.

ANALYSIS OF USED CORNPICKER VALUES

Chapter VII
INTRODUCTION

The examination of used cornpicker values is the last of the analyses done in this study. As before, the samples of used values are for 1953 and 1958 models, studied from 1953 through 1963 and 1958 through 1963 respectively. The format of the analysis remains unchanged from earlier chapters.

VARIABLES

Three new variables are introduced with the analysis of used cornpicker values, corn acreage, pull-type, and one-row. While these variables are specific to cornpickers, they do have analogies among the variables studied with other used machines.

Corn Acreage

This variable is conceptually the same for cornpickers as combined acreage was for combines, or livestock numbers for balers and forage harvesters. Cornpickers can perform only one field operation, that of harvesting corn. So long as the cornpicker remains an important harvesting method, (corn combining is emerging as a competitive technology), an increase in acreage should be expected to increase the demand for new and used cornpickers. An increase (decrease) in demand, of course, presumes an increase (decrease) in used values. Thus the numerical acreage of corn harvested was entered to examine this proposition.[1/]

Pull-type

This variable is analogous to the separation of combines into subpopulations of self-propelled and pull-type units. Cornpickers may be divided into pull-type units and tractor-mounted units. Although they perform the same function, the advantages of one over the other may result in a greater demand for one of these technically different types of cornpickers. The dummy variable pull-type was used to measure any difference in used values attributable to this technical variation.

One-row

This variable is somewhat analogous to the cutterbar-cornhead-pickup variables used with forage harvesters. Here again, with cornpickers, the header unit could become one criterion for evaluating used machines. The dummy variable one-row is used to determine if farmers' preferences for either the one or two row used cornpickers result in any significant difference in the rate of decline of their respective used values.

ESTIMATING EQUATIONS

Y=f (Age)

The following are the equations computed for a linear regression of used cornpicker values on age.

[1/] U.S.D.A., Agricultural Statistics-1965, (U.S. Government Printing Office, Washington, 1965), p. 449.

1953 Cornpickers

Equation #105 $\hat{Y}_1 = \underset{(1.198)}{57.580} - \underset{(0.193)}{4.094X_1}^{**}$

$R^2 = 0.7163$ S.E. = 7.4417

Equation #106 $\hat{Y}_2 = \underset{(1.097)}{57.282} - \underset{(0.177)}{4.643X_1}^{**}$

$R^2 = 0.7947$ S.E. = 6.8159

1958 Cornpickers

Equation #107 $\hat{Y}_1 = \underset{(1.322)}{71.183} - \underset{(0.395)}{6.917X_1}^{**}$

$R^2 = 0.6862$ S.E. = 6.6245

Equation #108 $\hat{Y}_2 = \underset{(1.202)}{68.676} - \underset{(0.359)}{7.254X_1}^{**}$

$R^2 = 0.7444$ S.E. = 6.0203

Where X_1 = age, R^2 is the coefficient of multiple determination, S.E. is the standard error of the estimating equation, ** indicates significance at the .01 level, and * indicates significance at the .05 level.

The above equations fit the pattern that we have learned to expect from previous chapters. Specifically, the b values for <u>age</u> are greater for the 1958 than for the 1953 models indicating curvilinearity, and deflation of the dependent variable results in an improved "fit" for linear equations.

<u>Y - f (Age, Make)</u>

The equations to follow include variables for both the age and make of the cornpicker.

1953 Cornpickers

Equation #109 $$\hat{Y}_1 = \underset{(1.666)}{61.460} - \underset{(0.163)}{4.094X_1^{**}} + \underset{(1.986)}{2.240X_2} - \underset{(1.986)}{9.445X_3^{**}}$$

$$+ \underset{(2.432)}{0.525X_4} - \underset{(2.432)}{7.475X_5^{**}} - \underset{(1.986)}{10.650X_6^{**}}$$

$$- \underset{(1.986)}{6.025X_7^{**}} - \underset{(2.432)}{4.295X_8} - \underset{(1.986)}{2.770X_9} - \underset{(1.813)}{1.885X_{10}}$$

$R^2 = 0.8081$ S.E. = 6.2802

Equation #110 $$\hat{Y}_2 = \underset{(1.585)}{60.426} - \underset{(0.155)}{4.643X_1^{**}} + \underset{(1.890)}{1.835X_2} - \underset{(1.890)}{8.000X_3^{**}}$$

$$+ \underset{(2.314)}{0.840X_4} - \underset{(2.314)}{5.890X_5^{**}} - \underset{(1.890)}{8.925X_6^{**}} - \underset{(1.890)}{4.805X_7^{**}}$$

$$- \underset{(2.314)}{3.370X_8} - \underset{(1.890)}{2.005X_9} \; \underset{(1.725)}{1.460X_{10}}$$

$R^2 = 0.8502$ S.E. = 5.9757

X_1 = Age
X_2 = Allis Chalmers
X_3 = Case
X_4 = Ford
X_5 = Ferguson
X_6 = John Deere
X_7 = International Harvester
X_8 = Massey Harris
X_9 = New Idea
X_{10} = Oliver

(Minneapolis Moline is the base for make comparisons.)

1958 Cornpickers

Equation #111 $$\hat{Y}_1 = \underset{(1.691)}{71.899} - \underset{(0.321)}{6.949X_1^{**}} + \underset{(2.000)}{1.718X_2} + \underset{(1.859)}{1.678X_3}$$
$$+ \underset{(2.197)}{3.997X_4} + \underset{(1.965)}{4.620X_5^{*}} - \underset{(1.859)}{1.088X_6} - \underset{(2.197)}{11.814X_7^{**}}$$
$$- \underset{(1.838)}{4.043X_8^{*}} - \underset{(1.838)}{1.683X_9}$$

$R^2 = 0.8048$ S.E. = 5.3812

Equation #112 $$\hat{Y}_2 = \underset{(1.534)}{69.758} - \underset{(0.291)}{7.281X_1^{**}} + \underset{(1.814)}{1.255X_2} + \underset{(1.686)}{0.916X_3}$$
$$+ \underset{(1.992)}{3.236X_4} + \underset{(1.782)}{3.793X_5^{*}} - \underset{(1.686)}{1.730X_6} - \underset{(1.992)}{11.133X_7^{**}}$$
$$- \underset{(1.667)}{4.118X_8} - \underset{(1.667)}{1.978X_9}$$

$R^2 = 0.8417$ S.E. = 4.8801

X_1 = age	X_4 = John Deere	X_7 = Massey Ferguson
X_2 = Allis Chalmers	X_5 = Ford	X_8 = New Idea
X_3 = Case	X_6 = International Harvester	X_9 = Oliver

(Minneapolis Moline is the base for make comparison.)

In contrast to the equations in previous chapters, most of the b values for makes which were significantly different from zero were also negative. Generalizing somewhat, this indicates that Minneapolis Moline was not (as assumed when it was chosen as base model) one of the lowest valued makes. Below is a list of the makes which exhibited b values significantly different from Minneapolis Moline.

$\underline{1953\ Y_1}$		$\underline{1953\ Y_2}$	
(-)	Case**	(-)	Case**
(-)	Ferguson**	(-)	Ferguson**
(-)	John Deere**	(-)	John Deere**
(-)	International Harvester**	(-)	International Harvester**
$\underline{1958\ Y_1}$		$\underline{1958\ Y_2}$	
(+)	Ford*	(+)	Ford*
(-)	Massey-Ferguson**	(-)	Massey-Ferguson**
(-)	New Idea*	(-)	New Idea*

Where ** indicates significance at the .01 level, * at the .05 level and (+) or (-) indicates the sign of the b value.

The contribution of the make variables taken together was significant at the .01 level for both 1953 and 1958 equations.

<u>Y=f (Age, Make, New Models</u>)

The following equations include variables for <u>new models.</u>

1953 Cornpickers

Equation #113 $\hat{Y}_1 = 58.950 - 3.637X_1^{**} + 2.420X_2 - 4.468X_3^{*}$

$(1.603) \quad (0.171) \quad (1.834) \quad (2.071)$

$+ 0.525X_4 + 0.669X_5 - 2.815X_6 + 3.117X_7$

$(2.247) \quad (2.743) \quad (2.364) \quad (2.452)$

$+ 1.134X_8 + 1.939X_9 - 1.132X_{10} - 7.526X_{11}^{**}$

$(2.480) \quad (2.084) \quad (1.684) \quad (1.782)$

$- 5.700X_{12} - 9.049X_{13}^{**}$

$(2.968) \quad (1.749)$

$R^2 = 0.8392$ S.E. = 5.8011

Equation #114 $\hat{Y}_2 = 58.335 - 4.263X_1^{**} - 1.835X_2 - 3.551X_3$

$(1.552) \quad (0.166) \quad (1.775) \quad (2.004)$

$+ 0.840X_4 + 1.390X_5 - 1.915X_6 + 3.053X_7$

$(2.174) \quad (2.654) \quad (2.288) \quad (2.373)$

$+ 1.483X_8 + 1.998X_9 - 0.786X_{10} - 6.741X_{11}^{**}$

$(2.399) \quad (2.017) \quad (1.630) \quad (1.725)$

$- 2.955X_{12} - 8.089X_{13}^{**}$

$(2.872) \quad (1.692)$

$R^2 = 0.8710$ S.E. = 5.6134

X_1 = age	X_5 = Ferguson	X_9 = New Idea
X_2 = Allis Chalmers	X_6 = John Deere	X_{10} = Oliver
X_3 = Case	X_7 = International Harvester	X_{11} = New Model #1
X_4 = Ford	X_8 = Massey Harris	X_{12} = New Model #2

X_{13} = Discontinuation of the line.

(Minneapolis Moline is the base for make comparisons.)

1958 Cornpickers

Equation #115 $\hat{Y}_1 = 71.076 - 6.239X_1^{**} + 1.243X_2 + 2.998X_3$

(1.533) (0.312) (1.781) (1.683)

$+ 3.624X_4 + 3.314X_5 - 0.663X_6 - 5.188X_7^{*}$

(1.983) (1.765) (1.667) (2.265)

$- 0.823X_8 - 1.403X_9 - 6.531X_{10}^{**}$

(1.735) (1.660) (1.224)

$- 6.078X_{11} - 4.667X_{12}^{**}$

(3.649) (1.435)

$R^2 = 0.8491$ S.E. = 4.7862

Equation #116 $\hat{Y}_2 = 69.023 - 6.683X_1^{**} + 0.867X_2 + 2.047X_3$

(1.424) (0.290) (1.653) (1.562)

$+ 2.991X_4 + 2.732X_5 - 1.341X_6 - 5.665X_7^{**}$

(1.841) (1.638) (1.548) (2.103)

$- 1.467X_8 - 1.693X_9 - 5.306X_{10}^{**}$

(1.610) (1.541) (1.137)

$- 5.285X_{11} - 4.078X_{12}^{**}$

(3.388) (1.332)

$R^2 = 0.8718$ S.E. = 4.4430

X_1 = age

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = Ford

X_6 = International Harvester

X_7 = Massey-Ferguson

X_8 = New Idea

X_9 = Oliver

X_{10} = New Model #1

X_{11} = New Model #2

X_{12} = Discontinuation of the line

(Minneapolis Moline is the base for make comparisons.)

The b values for new models in the above equations seem to support the rationale for including them. Each b value is negative, indicating a negative effect on the value of the original model as new models are introduced. Despite its numerical size, new model #2 was not significantly different from zero in its effect on used values. The b values for make are, in most cases, quite different from those of preceding equations. It should be remembered that coefficients for make measure something different in these equations than they did in the ones without new model variables. Before they measured the average relationship between a specific make and the base make over the time span. Here they measure the relationship between a specific make and the base make when the estimated effect of any new models introduced in the interim have been removed from the overall evaluation of the make.

The contribution of the new models variable was significant at the .01 level in each equation.

Y = f (Age, Make)---Curvilinear Model

The following equations use $X_1 + X_1^2$ to represent age, thus fitting a curvilinear equation to the data.

1953 Cornpickers

Equation #117 $\hat{Y}_1 = 66.130 - 6.429X_1{**} + 0.212X_1^2{**} + 2.420X_2{*}$

$(2.122) \quad (0.705) \quad (0.063) \quad (1.927)$

$- 9.445X_3{**} - 0.525X_4 - 7.475X_5{**} - 10.650X_6{**}$

$(1.927) \quad (2.360) \quad (2.360) \quad (1.927)$

$- 6.025X_7{**} - 4.295X_8 - 2.770X_9 - 1.885X_{10}$

$(1.927) \quad (2.360) \quad (1.927) \quad (1.759)$

$R^2 = 0.8205$ S.E. = 6.0931

Equation #118 $\hat{Y}_2 = 68.460 - 8.660X_1{**} + 0.365X_1^2{**} + 1.835X_2$

$(1.885) \quad (0.617) \quad (0.055) \quad (1.685)$

$- 8.000X_3{**} + 0.840X_4 - 5.890X_5{**} - 8.925X_6{**}$

$(1.685) \quad (2.063) \quad (2.063) \quad (1.685)$

$- 4.805X_7{**} - 3.370X_8 - 2.005X_9 - 1.460X_{10}$

$(1.685) \quad (2.063) \quad (1.685) \quad (1.538)$

$R^2 = 0.8816$ S.E. = 5.3271

X_1 = age

X_1^2 = Age^2

X_2 = Allis Chalmers

X_3 = Case

X_4 = Ford

X_5 = Ferguson

X_6 = John Deere

X_7 = International Harvester

X_8 = Massey Harris

X_9 = New Idea

X_{10} = Oliver

(Minneapolis Moline is the base for make comparisons.)

1958 Cornpickers

Equation 119 $\hat{Y}_1 = 69.710 - 5.085X_1{**} - 0.309X_1^2 + 1.673X_2$

(2.551) (1.659) (0.270) (1.998)

$+ 1.645X_3 + 3.997X_4 + 4.620X_5{*} - 1.072X_6$

(1.857) (2.194) (1.963) (1.857)

$- 11.813X_7{**} - 4.043X_8{*} - 1.683X_9$

(2.194) (1.836) (1.836)

$R^2 = 0.8067$ S.E. = 5.3749

Equation #120 $\hat{Y}_2 = 69.148 - 6.763X_1{**} - 0.086X_1^2 + 1.243X_2$

(2.324) (1.511) (0.246) (1.820)

$+ 0.907X_3 + 3.237X_4 + 3.793X_5{*} - 1.726X_6$

(1.692) (1.999) (1.788) (1.691)

$- 11.133X_7{**} - 4.118X_8{*} - 1.978X_9$

(1.999) (1.672) (1.672)

$R^2 = 0.8418$ S.E. = 4.8964

X_1 = age

X_1^2 = age^2

X_2 = Allis Chalmers

X_3 = Case

X_4 = John Deere

X_5 = Ford

X_6 = International Harvester

X_7 = Massey Ferguson

X_8 = New Idea

X_9 = Oliver

(Minneapolis Moline is the base for make comparisons.)

In explaining used values for the 1953 models (ten-year span), the curvilinear model above was a significant improvement over comparable linear models; but this was not so for the 1958 models (five-year span). In the 1953 equations, the b values for the age squared term were positive and significantly different from zero. The b values for this variable in the 1958 equations were exactly opposite on both counts--negative and not significantly different from zero. In either case, the b values for make remain relatively unchanged.

INTERPREATATION

As in all the previous chapters, every effort has been made to obtain information about the variables which is not readily apparent from the regression equations. Each of the variables will be discussed in turn regardless of whether it was included in the regression equations presented.

Age

The b values for age were significantly different from zero at the .01 level for all the equations recorded. These b values were also very consistent throughout the 1953 and 1958 equations. According to t-tests, only the b values for equations #108---Y_2=f (Age)--and #116---Y_2=f (Age, Make, New Models)---for 1958 models were significantly different. As before, this consistency is evidence that the other variables complement age rather than displace it.

It is interesting to note that age was not capable of explaining as much of the variation in used values of corn-pickers as it did for the other pull-type machines. Age alone explained 80% of the variation in nominal value for balers, 81% to 89% for forage harvesters, 79% to 83% for pull-type combines, but only 69% to 72% for cornpickers.

The average yearly residuals for the 1953 equations point toward the usefulness of a curvilinear model. This does not appear to be the case with 1958 models. (See Table 34.)

Realized Net Farm Income

The realized net farm income variable was significant (at .01 level) for all the 1953 cornpicker equations and has a relatively large effect (total variation in used value due to RNFI was 3.6%). This was not true for the 1958 equations. Here the variable was significant for the Y_1 equations at the .05 level, but not usually significant for Y_2 equations. In both instances, the b values for the 1958 equations are negative. This, of course, is an unacceptable finding. As a result, RNFI was once again not included in the equations given in the chapter.

TABLE 34---Average yearly residuals (actual value-estimated values for) 1953 and 1958 cornpickers, computed from equations # 105 and 107.

Equation	Age in Years 1	2	3	4	5	6	7	8	9	10
	Average Residual (in Percentage Points)									
1953 Eqn. # 105	7.54	-3.50	-2.45	-3.91	-2.22	1.49	2.40	1.37	-0.06	0.79
1958 Eqn. # 107	-1.74	2.66	-0.34	0.42	-0.25					

Makes

With cornpickers, the strongest case yet may be made considering the effect of make as varying as a function of time. In this instance, the best linear estimates of the effect of make actually increase the standard error of estimates for the first two years of the ten-year span. The information in Table 35 indicates that while a linear estimate of the effect of makes was very helpful in explaining used values for older cornpickers, it was actually detrimental to the explanation of used values of cornpickers under two years old.

As a group, the make variables were significant at the .01 level for both 1953 and 1958 models. Those individual makes which were significant usually had negative b values. In other words, they were worth significantly less than the base make, Minneapolis Moline.

It is difficult to describe the make relationships for cornpickers because there were very few which were consistent between the 1953 and 1958 equations. Not only this, but the makes seemed to be grouped along a continuum. The best that can be done is to report these groupings for each equations. The following is a short-cut method of doing this, yet probably more understandable than any other method. The makes are listed in order of declining b values and dashed lines are

TABLE 35---The standard error of estimates calculated for each year from equations # 105 and # 109.

Equation	Age in Years 1	2	3	4	5	6	7	8	9	10
	Standard Error									
(1) Y_1=f (Age)---Eqn. # 105	9.73	6.47	4.80	5.99	5.86	7.24	7.77	7.32	8.45	8.77
(2) Y =f (Age,Make)---Eqn. # 109	10.69	7.89	4.59	5.54	4.10	4.93	5.57	4.81	6.28	7.29
% (2) / (1)	109.8%	121.9%	95.6%	92.4%	69.9%	68.0%	71.6%	66.1%	74.2%	83.1%

drawn under those which were not significantly different from each other.

```
          Highest b Value-    _Lowest b Value-
1953 AC, FD, MM, OL, NI, MH, INT. FERG, CA, JD.
    -----------
         --------------
             --------------
                     ------------------
                             ------------------
```

Example: MH was not significantly different from MH or FERG, but it was significantly different from CA and JD. Thus, MH had a significantly larger percentage value than either CA or JD.

```
1958 FD, JD, AC, CA, MM, IH, OL, NI, MF.
     ----------
         --------------
             ------------------
                         ----------
```

Example: IH, OL, NI were not significantly different, but each one of them had significantly larger percentage value than MF. MF was worth significantly less in percentage terms, than all other makes.

AC = Allis Chalmers

MM = Minneapolis Moline

FD = Ford

OL = Oliver

NI = New Idea

MH = Massey Harris

FERG = Ferguson

MF = Massey Ferguson (Massey Harris and Ferguson merged)

IH = International Harvester

CA = Case

JD = John Deere

<u>One-Row</u>

Consistent results were not obtained for this variable. In the 1953 equations the b value for <u>one-row</u> was positive and significant. For the 1958 equations the b value was nearly the same numerically, but negative and lacked significance. The variable was simply omitted as unimportant in calculating the final equations.

<u>Pull-Type</u>

This variable was also omitted from the later equations. It was significant and negative for 1953, but positive and lacked significance in 1958. This pattern of results might indicate that farmers wishing to find mounted cornpickers to fit their older model tractors were willing to pay a slight premium for them. Such a conclusion rests upon the inability to acquire new cornpickers that can be mounted on the earlier model tractors. A check on this proposition indicated that a new mounted cornpicker could be purchased for "60" model John Deere tractor, one of the 1953 models used in this study. Thus, it may be assumed that little real difference exists between percentage value for pull type and mounted cornpickers.

Corn Acreage

Although the corn acreage was significant at the .05 level for 1953 Y_1 and 1958 Y_2 equations, it is clearly possible that the variable was not measuring the effect of changes in corn acreage harvested on used cornpicker values. The data for corn acreage is negatively intercorrelated with age (-0.6027 for 1953 and -0.7872 for 1958). It could be presumed that corn acreage measures a part of the decline in value previously accounted for by age. The decrease in the size of the b value for age with the addition of corn acreage in the above equations, seems to be consistent with this possibility.

For the 1953 Y_2 and 1958 Y_1 equations, corn acreage was not significant. Had these results been significant, one would be much less dubious about the importance of the corn acreage variable.

New Models

The new models variable was significant at the .01 level for all the cornpickers. These results were the first to be reasonable for all the equations of a given machine. For 1953, with the introduction of one new model the value of the existing model would decrease by 7.5 percentage points. The second new model resulted in an additional decline of 5.7 percentage points. Finally discontinuation of the line resulted in one more drop of 9.0 percentage points. The total cummulative effect of all these variables is a 22.2 percentage point decline in used values. A similar effect is obtained with the co-efficients from the 1958 equations.

Inflation

Cornpickers also decrease in "real" value more rapidly than in "nominal" value. The difference in b values for age between Y_1 equations and comparable Y_2 equations contrast their relative rates of decline. This difference ranges from 0.54 to 0.63 percentage points for 1953 equations and 0.33 to 0.44 for the 1958 equations. One would expect the difference to be less for the shorter time span of the 1958 equations provided the rate of inflation during this period did not exceed the average over the longer span.

Deflation of the used values again improves the fit of the equations. This improvement in fit may be thought of as the contribution of inflation to understanding used cornpickers values. Once again inflation appears to have an important effect on used values.

Curvilinear Model

The curvilinear model used here is based upon the addition of age squared variable to the existing model. Age squared was significant for the 1953 equations, but not for the 1958 equations. This is not a surprising result, as discussed in previous chapters.

The following table illustrates the curvilinear model for cornpickers.

TABLE 36---Estimated percentage values and yearly "loss-in-value" as a percent of original value, computed from equations #109 and #117.[a]

Equation	Age in Years 1	2	3	4	5	6	7	8	9	10
Percentage Values										
Eqn. #117---Curvilinear Model	59.9	54.1	48.8	43.8	39.3	35.2	31.5	28.3	25.4	23.0
Eqn. #109 ---Linear Model	57.4	53.3	49.2	45.1	41.0	36.9	32.8	28.7	24.6	20.5
"Loss-In-Value"										
Eqn. #117---Curvilinear Model	40.1	5.8	5.3	5.0	4.5	4.1	3.7	3.2	2.9	2.4
Eqn. #109---Linear Model	42.6	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1

[a] The effect of make is not included in these values.

Once again the curvilinear equation is an improvement over the linear models (for the ten year span), but exhibits a pattern in its yearly residuals.

Summary

Age was once more the most important variable, accounting for 69% to 72% of the variation in used cornpicker values. It does not, however, account for as much of the variation as it did with the other pull type machines.

With the notable exception of corn acreage, the variables seem to be complements of the age variable.

Realized Net Farm Income was a significant variable, with a larger than typical effect, for 1953 models. But, for the 1958 models it was negative and lacked significance.

A very persuasive case for the effect of make varying as a function of time was made using 1953 cornpickers. The inclusion of make, while useful for most of the 1953-1962 period, was deterimental to the accuracy of value estimates for one and two year old cornpickers.

Makes were once again useful for explaining used cornpicker values, but would not be very helpful for predicting values outside the data. No consistent ranking of makes for 1953 and 1958 models was obtainable.

There are probably no important differences in percentage values between one and two row cornpickers, or pull type and mounted cornpickers.

TABLE 37---Average yearly residuals (actual value--estimated value) from equation #117 ---curvilinear model.

	Age In Years									
Equation	1	2	3	4	5	6	7	8	9	10
	Average Yearly Residuals In Percentage Points									
Eqn. # 13--- Curvilinear Model	5.45	-4.35	-2.59	-2.64	-1.25	3.19	3.68	1.76	-1.45	-1.84

The amount of corn acreage harvested does not seem to have an effect on used values of cornpickers, at least with the variation of data within the period of this study.

Cornpickers were the only machines studied where the effect of the new model variables was reasonable for all equations.

The "real" values of used cornpickers declined from 0.33 to 0.44 percentage points faster than "nominal" values for the 1958-1963 period, and 0.54 to 0.63 faster for the 1953-1963 span. Deflation of the used values improved the "fit" of both 1953 and 1958 equations.

The curvilinear model was useful with the 1953 equations, but not with 1958 equations.

To follow is a summary of estimated first year values, tenth year values, and rates of "loss-in-value" which should be some guide to expected used cornpicker values for models other than 1953 and 1958. First year value estimates ranged from 53.5% to 65.0% (of original value). Tenth year values varied from 16.6% to 23.0%. Linear estimates of yearly "loss-in value" for the ten year period were from 3.6% to 4.1%. The curvilinear model indicated that yearly loss-in-value declined from 5.8% (second year, omitting initial value drop) to 2.4% over the same period.

APPLICATION OF THE RESEARCH RESULTS AND GENERAL CONCLUSIONS

CHAPTER VIII

There are two parts to this concluding chapter. The first deals with the application of the research findings, and the second gives some general conclusions of the study.

APPLICATION OF THE RESEARCH RESULTS

This section deals with the application of the research findings, and with the implications of their use in management situations.

An Argument For Applying the Research Results

The inadequacy of common depreciation schemes as estimators of used farm machinery values was well illustrated in Chapter I. The usefulness of applying the findings of this study rests with their capacity to provide more accurate used value estimates (and resultant cost estimates) than the traditional depreciation methods. Any comparison of accuracy must be made using data other than that which the regression equations were based upon. Consequently the equations are applied to a randomly selected sample of 1956 model machines. Table 38 provides an indication of the usefulness of the estimating equations. Both the simple linear model and the more complex curvilinear model seem to offer a sizable reduction of the amount of error in used value estimates.

TABLE 38---The "standard difference"[a] for different methods of estimating used values of randomly selected 1956 model farm machinery.

Machine	Straight Line Depr.	Str. Line+ 20% Add.	Declining Balance	Sum of Digits	Linear Model[b]	Curv. Model[c]
	Method of Estimating Used Machinery Values					
Tractors	(Percentage Points)					
Allis Chalmers "WD-45"	24.6	22.8	29.3	29.7	13.4	16.7
Case "411"	17.8	18.0	24.2	24.5	5.9	11.5
-PULLTYPE COMBINES-						
John Deere "65"	20.9	25.2	28.2	28.4	6.7	6.8
-SELF PROPELLED COMBINE-						
Gleaner Baldwin "A"	15.8	12.2	17.1	17.8	6.6	12.4
-BALER-						
International Harvester "45-T"	19.4	8.7	9.9	11.7	2.9	3.8
-FORAGE HARVESTER-						
Gehl	16.3	9.7	15.2	15.9	6.6	5.8
-CORNPICKER-						
Minneapolis Moline "Husker"	18.1	10.3	16.8	18.2	11.0	6.1
AVERAGE	17.5	15.2	20.1	20.8	7.5	9.0

[a]"Standard difference" is used in place of standard error because conceptually depreciation methods have no standard errors. It is computed from the difference between estimated used values and actual used values. The method is the same as the computation of standard errors.

[b]Linear Model was the simple equations $Y_1 = f$ (Age)

[c]Curvilinear model--Y-f (Age,+Age^2,make,---,)--did not include adjustments for make and other variables.

Choice of Estimating Equations

Some consideration must be given to choosing the most appropriate equation for a given application. To a great extent the choice consists of selecting between simple Y = f (Age) and more complex models; and equations for either the five year or the ten year span.

While the complex equations reported in this study were very useful in explaining "loss-in-value", they may be less satisfactory for predicting used values than their simpler counterparts. This is illustrated by the evidence that the relative adjustments for make, as given by the equations for 1953 models, were not at all applicable to 1958 models. In view of this experience, they could hardly be expected to apply to other model years. Suppose that the curvilinear model is chosen as the basis of used machinery value estimates, but the effect of make is simply ignored. (This was exactly the method used to derive the results given under "curvilinear model" in Table 38.) Since the "loss-in-value" related to age seems to be best fit with a curvilinear function, such an approach would appear to have some merit. Used values estimated by this method, however, tend to be rather conservative. This is, without doubt, the result of a deliberate choice of the "base" make such that all or most of the make variable coefficients would be positive.

Circumstantially the various makes do not average out as they do with the Y=f (Age) equations. This is illustrated in Table 38. One might conclude, therefore, that the simplest equations ---Y=f (age)---are as useful as any of those derived in this study for approximating used machinery values (of other than 1953 and 1958 models).

The choice between the five and ten year estimating equations is probably rather obvious. If the machine in question is less than five years old, the five year span equations should give the best estimates. If one is concerned with applications involving periods longer than five years, some of the accuracy of the first five years must be compromised to obtain the better overall estimates from the 1953-1963 equations. Extension of the 1958-1963 equations beyond the five year limit results in too rapid a "loss-in-value" in the later years.

It would have been most convenient if the coefficients of the Y=f (Age) equations for balers, forage harvesters, cornpickers, and pull type combines had not been significantly different. In such a case, one equation could have been developed for estimating the used values of all these machines. (This would have involved pooling the data and computing a single regression equation for each model --- 1953 and 1958.)

Such a proposition was tested using covariance analysis.

Equations for 1953 pull type combines and cornpickers were not significantly different at the .05 level. This was also true of 1958 model cornpickers and pull type combines. The 1953 equations for forage harvesters and cornpickers also were not significantly different. But here the procession toward a single estimating equation came to halt. The 1958 equations for cornpickers and forage harvesters were significantly different at the .05 level. Both 1953 and 1958 baler equations were found to be significantly different from the respective 1953 and 1958 equations for all the other machines. Consequently, the possibility of a single estimating equation for pull type machinery, for either 1953 or 1958 models, must be ruled out.

Application of the Research Results to Farm Management

The following discusses the application of the research findings to certain farm management problems and some resultant conclusions. This discussion assumes that machinery cost estimates are typically made using common depreciation methods.

One might be especially interested in the comparisons with straight line depreciation methods, since at least one well known farm management guide recommends this method for computing farm machinery costs.[10/]

[10] Doane Farm Management Guide (Doane Agricultural Service, Inc., St. Louis 8, Missouri) p. 341.

The analyses on the next few pages suggest these conclusions: (1) Used farm machinery may be a better alternative than is assumed from calculations based on common depreciation methods. (2) Long run ownership costs of farm machinery are less than would have been assumed from depreciation schemes. (3) Farm machinery used for only a few years is relatively more expensive, and machinery used several years is relatively less expensive, in terms of average annual ownership costs, than would be assumed using common depreciation methods.

Examination of Table 39 and Table 40 direct one toward the first conclusion. Here it is illustrated that the first year's "loss-in-value", as computed from the estimating equations, greatly exceeds the depreciation given by commonly used methods. In fact, the equations indicate that more than half of the ownership costs (defined here as either estimated "loss-in-value" or depreciation) of ten years of forage harvester use were borne during first year. (A similar situation was found for the other machines examined.) This extremely large first year cost would, of course, be avoided by purchasing a used machine.

Even when a farm machinery dealer's profit is included in the used machine's purchase price, resulting in a price that is somewhat higher than the "as-is" market value, the

TABLE 39---Estimated used values for a $2415.00 forage harvester, computed from various depreciation systems; and equations #69 and #81 of Chapter V.[a]

Method of Computation	Years of Age 1	2	3	4	5	6	7	8	9	10
Linear Model--Eqn.#69	$1382	$1279	$1176	$1073	$ 970	$ 867	$764	$661	$558	$455
Curvilinear Model--Equation #81	1367	1240	1115	1000	892	791	697	608	526	452
Straight Line Depreciation	2198	1981	1764	1547	1330	1113	896	679	462	245
Straight Line + 20%	1763	1594	1425	1256	1087	918	749	580	411	242
Declining Balance	1932	1546	1237	991	793	643	509	408	326	261
Sum of Digits	2019	1664	1348	1071	835	637	481	363	284	246

[a] $2415 was the approximate new cost of a GEHL "Chop-All" Forage Harvester.

TABLE 40---Estimated yearly ownership costs for a $2415.00 forage harvester, computed from various depreciation systems; and equation #69 and #81 of Chapter V.[a]

METHOD OF COMPUTATION	Years of Age 1	2	3	4	5	6	7	8	9	10	TOTAL
Eqn. #69--- Linear Model	$1033	$103	$103	$103	$103	$103	$103	$103	$103	$103	$1960
Eqn. #81--- Curvilinear Model	1048	127	125	115	108	101	94	89	82	74	1963
Straight line Depreciation	217	217	217	217	217	217	217	217	217	217	2170
Straight line + 20%	652	169	169	169	169	169	169	169	169	169	2173
Declining Balance	483	386	309	246	198	159	125	101	82	65	2154
Sum of Digits	396	355	316	277	236	198	156	118	79	38	2169

[a] "Ownership costs" refer to the amount of depreciation or "loss-in-value", whichever is applicable.

first proposition still seems to hold. For the purpose of illustration, the following example contrasts the ownership costs of a new forage harvester with a one-year-old model. The computations are based on straight line depreciation with 20% additional first year allowance and equation #69. (Straight Line depreciation is not used as it should be recognized that first year's "loss-in-value" is greater than 10%.) Let us assume that the dealers' price is 25% higher than the "as-is" value of the machine. (This is the same as assuming a 20% profit on gross sales as is done by the Official Guide. See Chapter II.) The example involves total ownership costs for nine years of use:

Straight Line + 20% Depreciation:[a]				Total Ownership Costs
(1) New Machine---				
$2415 (New Cost)	- $ 411 (9th Yr. Value)		=	$2004
(2) Used Machine---				
$1763 (1st. Yr. Value)	+(1763 X 25%) (Dealer Profit)	$242 (10th Yr. Value)	=	$1962
		Difference		$ 42

[a] These values are given by "straight line depreciation +20%" in Table 39.

Equation #69---Linear Model[b]				Total Ownership Costs
(1) New Machine---				
$2415 (New Cost)	- $558 (9th Yr. Value)		=	$1857
(2) Used Machine---				
$1382 (1st Yr. Value)	+(1382X25%) (Dealer Profit)	-$445 (10th Yr. Value)	=	$1273
		Difference		$ 584

[b] These values are given by "Linear Model---Eqn. #69" in Table 39.

With this example, the equation estimated the difference in total ownership costs, between a new and a one-year-old machine (each used nine years), as $542 more than was calculated by the depreciation method.

It was no doubt observed in Table 40 that total forage harvester ownership costs, for the ten year period, were smaller if the computations were based on the estimating equations, rather than depreciation schemes. Table 41 illustrates that accumulative ownership costs computed by this method were less than those given by depreciation schemes for even shorter periods of time. Note that total ownership costs for a 1956 tractor, baler, and self propelled combine as measured by the estimating equations---were less than those given by "sum of digits" and "declining balance" methods by the end of the fourth year, less than "straight line + 25%" by the sixth year, and smaller than"straight line" method by the eighth year. (Examples from pull-type combines and cornpickers could have been used equally as well to illustrate this phenomenon.) This application of the research findings leads directly to the second conclusion.

If one looks at the average yearly ownership costs for different periods of use, (Tables 42 and 43) it is discovered that estimates based on the research findings are higher

TABLE 41---Total ownership costs for selected machinery used a varying number of years, as computed from estimating equations and depreciation methods.

Method Of Computation	Years The Machine Was Used 4	6	8	10
---1956 Farmall "400" Tractor - $3350---				
Linear Equation	$1608	$1814	$2020	$2226
Straight Line Depr.	1206	1809	2412	3015
Straight Line + 20%	1608	2077	2546	3015
Declining Balance	1978	2466	2848	3013
Sum of Digits	1863	2472	2788	2990
---1956 John Deere "45" Self-Propelled Combine - $4900---				
Linear Equation	$2293	$2659	$3024	$3390
Straight Line Depr.	1764	2646	3528	4410
Straight Line + 20%	2352	3038	3724	4410
Declining Balance	2893	3616	4078	4374
Sum of Digits	2725	3606	4166	4406
---1956 New Holland "66" PTO Baler - $1400---				
Linear Equation	$ 627	$ 773	$ 917	$1062
Straight Line Depr.	504	756	1008	1260
Straight Line + 20%	672	868	1064	1260
Declining Balance	827	1033	1165	1250
Sum of Digits	778	1031	1190	1259

for short periods of use and lower for longer periods of use than those computed from depreciation schemes. This should be expected, considering the high initial "loss-in-value" and the lower long-run ownership costs previously observed. The third conclusion follwos directly from this analysis.

Considering conclusions 1,2, and 3; there are three apparent economic adjustments that alert farm managers might find useful. (1) Other things being equal, used machinery could be purchased instead of new equipment, thereby reducing total ownership costs over a given period of time. (2) The use of additional or larger machinery may be justified by lower than previously expected long-run ownership costs. (3) Farm machinery may possibly be used for longer periods of time in order to take advantage of the lower average ownership costs.

The farm manager who is examining the relative merits of diesel and gasoline tractors will be interested in what might be termed the "hidden cost" of owning a diesel. While depreciation schemes do not differentiate between gasoline and diesel tractors, the research findings indicate that "loss-in-value" was more rapid for diesel units. (This may cease to be the case in the furture, as an increased portion of the farm tractor population becomes diesel powered.) This faster rate of decline

TABLE 42---Average annual ownership costs for a $2415 forage harvester, computed from various depreciation systems and equations #69 and 81 of Chapter V.

Method Of Computation	Number Of Years The Machine Is Owned									
	1	2	3	4	5	6	7	8	9	10
Linear Model--Eqn. #69	$1033	$568	$413	$336	$289	$258	$236	$219	$206	$196
Curvilinear Model--Eqn. #81	1048	586	433	354	305	271	245	226	210	196
Straight Line Depreciation	217	217	217	217	217	217	217	217	217	217
Declining Bal.	483	435	393	356	324	297	272	251	232	215
Sum of Digits	396	376	356	336	316	296	279	257	237	217

TABLE 43---Average annual ownership costs for selected machines and periods of use, computed from the estimating equations and various depreciation schemes.

Method Of Computation	Years The Machine Was Used 4	6	8	10
---1956 Farmall "400" Tractor-$3350---				
Linear Model	402	302	253	223
Straight Line Depr.	302	302	302	302
Straight Line + 20%	402	346	318	302
Declining Balance	495	411	356	301
Sum of Digits	466	412	349	299
---1956 John Deere "45" Self Propelled Combine-$4900---				
Linear Model	573	443	378	339
Straight Line Depr.	441	441	441	441
Straight Line + 20%	588	506	466	441
Declining Balance	723	603	510	437
Sum of Digits	681	601	521	441
---1956 New Holland "66" PTO Baler--$1400---				
Linear Model	157	129	115	106
Straight Line Depr.	126	126	126	126
Straight Line + 20%	168	145	133	126
Declining Balance	207	172	146	125
Sum of Digits	195	172	149	126

is, in effect, an additional cost to the diesel owner. The following example illustrates this "hidden cost". Suppose a 1958 "D-17" Allis Chalmers tractor that could be purchased as gasoline unit for $3200 is compared with a diesel unit priced at $4000. According to equations #5 and 7, they would have been worth $1695 and $1970, gasoline and diesel respectively in 1963. The total ownership costs for five year's use would have been $1505 for the gasoline tractor and $525 more, or $2030, for diesel tractor. Had gasoline and diesel tractors "loss-in-value" been at the same rate (gasoline tractor rate); total ownership costs for the diesel would have been estimated at $1877, or $153 dollars less than they probably were. Since the additional costs of owning a diesel model should be covered by savings in fuel costs; the diesel tractor must operate at $105 a year less than comparable, gasoline models. The "hidden costs", described above, account for $30.60 of this needed fuel savings.

The farmer is often concerned with developing some measure of his net worth. Accurate estimates of the current value of his assets are essential to calculating a net worth statement. Table 44 contrasts the use of depreciation methods and estimating equations for this purpose. One will immediately notice that the only difference between Statement

#1 and Statement #2 is the choice of combines. Yet, the depreciation methods giving the best "total value" estimates, compared to the Official Guide column, are not the same for both statements. A closer inspection reveals that even the best "total value" estimates obtained with depreciation methods result from errors of overestimation and underestimation cancelling each other out. In short, the use of a combination of the five year estimating equations (for machinery less than five years old) and ten years equations is a better technique for deriving the used farm machinery values for inclusion in net worth statements.

Still another application of the research findings might be useful. The tax laws have recently been changed to prevent farmers from considering the excess of the sales value of farm machinery over its depreciated value (as shown on the tax forms) as capital gains. Since this excess is now taxable as regular income, the farmer may wish to know how the market value of his farm machinery compares to depreciated values over time. With this knowledge he would be in a better position to balance the gains from rapid "write-offs" against future tax liabilities, and choose a depreciation method that best fits his tax strategy. Table 45 contrasts estimated market values from linear equations with depreciated values computed by different methods. The negative

TABLE 44---Estimated 1965 values of selected combinations of farm machinery; computed from various depreciation schemes, estimating equations[a], and "as-is" figures from the Official Guide.

	Method of Estimating Used Value					
Maehines	"Official Guide"	Linear Models	Straight Line	Straight Line+20%	Declining Balance	Sum of Digits
---Statement # 1---						
1962 "3010" John Deere Tractor	$2,690	$2,742	$3,250	$2,627	$2,279	$2,468
1957 "35" Massey Ferguson Tractor	1,068	963	630	540	378	337
1955 "6" New Idea Cornpicker	234	256	154	154	165	154
*1964 "55" John Deere Self-Propelled Combine	4,328	4,272	6,091	4,885	5,354	5,598
1958 "Chop-All" Gehl Forage Harvester	531	516	609	510	345	327
TOTAL	8,851	8,749	10,734	8,716	8,176	8,903
---Statement # 2---						
1962 "3010" John Deere Tractor	$2,690	$2,742	$3,250	$2,627	$2,279	$2,468
1957 "35" Massey Ferguson Tractor	1,068	963	630	540	378	337
1955 "6" New Idea Cornpicker	234	256	154	154	165	154
*1956 "45" John Deere Self-Propelled Combine	1,664	1,327	931	833	658	574
1958 "Chop-All" Gehl Forage Harvester	531	516	609	510	345	327
TOTAL	6,127	5,804	5,574	4,664	3,825	3,879

[a] A combination of five year and ten year linear equations was used.

TABLE 45---Amount of taxable income (market value - depreciated value) if a 1956 Allis Chalmers "WD-45" gasoline tractor was sold after a given number of years of use.

	Years Of Use									
Method of Depreciation	1	2	3	4	5	6	7	8	9	10
	-----Taxable Income (Market Value-Depreciated Value)-----									
Straight Line	-$465	-$324	-$184	$ 62	$ 80	$303	$355	$568	$672	$786
Straight Line + 20%	- 72	25	121	324	299	477	486	656	715	786
Declining Balance	- 225	68	296	564	560	739	704	808	800	764
Sum of Digits	- 312	40	187	498	517	739	835	852	824	786
Linear Model	118	129	140	257	148	239	162	246	219	204

"taxable income" indicates the amount of additional depreciation that could have been taken up to that particular point without the depreciated value falling below the market value of the machine. The positive "taxable income" indicates the amount of taxable income if the machine were sold at its market value.[11] Note that the linear model could reasonably be substituted for unknown values in this type of analysis.

Application of the Research Results to Farm Machinery Credit

Table 46 considers a large number of combinations of maturities and downpayments for a baler loan with payments due once a year. To the unpaid balance of these various loans is matched the used value of a baler in percent of its original costs. In addition, the table gives the annual payment as a percent of the cost of machine. (The payments in this example are a bit unique, as they involve equal payments on the principle). The underlined figures are where the value of the baler first equals the unpaid balance of the loan. When this occurs the loan will be considered "safely secured".

[11] This statement is not entirely true since the new law applies to depreciation taken after 1960. But for purposes of illustration this complication was thought unnecessary.

TABLE 46---Used baler values (equation #101[a]) as contrasted to the unpaid balance for loans of selected terms, (including yearly payment as a percent of the total loan).

Maturity (Years)	Down Payment	1	2	3	4	5	6	7	8	9	10	Amt. of Pay. (% of Cost)
		---Value of the Baler (Percent of Original Cost)---										
		64.9	58.4	52.3	46.5	41.0	35.8	31.0	26.5	22.2	18.4	
		---Unpaid Balance (Percent of Original Cost)---										
2	0%	100.0	50.0									50.0
2	10%	90.0	45.0									45.0
2	20%	80.0	40.0									40.0
2	30%	70.0	35.0									35.0
3	0%	100.0	66.6	33.3								33.3
3	10%	90.0	60.0	30.0								30.0
3	20%	80.0	53.3	26.6								26.6
3	30%	70.0	46.7	23.4								23.3
4	0%	100.0	75.0	50.0	25.0							25.0
4	10%	90.0	67.5	45.0	22.5							22.5
4	20%	80.0	60.0	40.0	20.0							20.0
4	30%	70.0	52.5	35.0	17.5							17.5
5	0%	100.0	80.0	60.0	40.0	20.0						20.0
5	10%	90.0	72.0	54.0	36.0	18.0						18.0
5	20%	80.0	64.0	48.0	32.0	16.0						16.0
5	30%	70.0	56.0	42.0	28.0	14.0						14.0
6	0%	100.0	83.3	66.6	49.9	33.2	16.5					16.6
6	10%	90.0	75.0	60.0	45.0	30.0	15.0					15.0
6	20%	80.0	66.7	53.4	40.1	26.8	13.5					13.3
6	30%	70.0	58.3	46.6	34.9	23.2	11.5					11.7
8	0%	100.0	87.5	75.0	62.5	50.0	37.5	25.0	12.5			12.5
8	10%	90.0	78.7	67.4	56.1	44.8	33.5	22.2	10.9			11.3
8	20%	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0			10.0
8	30%	70.0	61.2	52.4	43.6	34.8	26.0	17.2	8.4			8.8

[a] In the case of balers, the curvilinear model, ignoring <u>make</u>,is a very good estimate of used baler values.

Checking over the table we find the following:

1) No loan is "safely secured" the first year.
2) The year a loan is "safely secured" is not necessarily a function of its length of maturity.
3) The amount of the down payment has a large effect on when the loan is "safely secured".
4) The larger the down payment and the longer the repayment period, the easier the loan payments should be to meet.

Although not at all surprising individually, the interrelation of these factors yields some interesting results. For example, a five-year-20% down payment loan is "safely secured" the same year as a three-year-10% down payment loan, and the payments are nearly halved. A six-year-30% down payment loan is "safely secured" at the same time as a two-year-30% down payment loan, and the payments are only one-third of those for the latter. In light of this information, lenders should re-examine their present practices for extending credit for farm machinery. Perhaps it would be possible for lending agencies to improve their agricultural credit services if better information about used machinery values were provided them.

GENERAL CONCLUSIONS

This section is intended to cover only the more general conclusions of this study. More specific information on the effect of each variable is given in the summary section at the end of every analysis chapter.

Age

Age, as had been anticipated, was the most important of the variables hypothesized to have an effect on used machinery values. It alone was capable of explaining from 57% to 89% of the variation in used value for the machines in this study. The consideration of additional variables, in general, does not seem to alter the effect of age. Most of these additional variables provide information which supplements that already obtained from age.

The rate of "loss-in-value" associated with age tends to decline as the machine gets older. This point was illustrated quite conclusively, by the improved fit of the curvilinear models for all the machines studied over the ten year span, 1953 through 1963.

Realized Net Farm Income

The RNFI variable was expected to help explain the upward and downward shifts of used machinery values (as found in Table 6, Chapter II), but the results of its use ranged from a small effect to the completely unacceptable response of negative coefficients.

Make

It was somewhat of a surprise to find that it would be impossible to give a consistent 1-2-3----n ranking of the different makes. Consequently the information provided by the *make* variables is not very useful for predicting used values of machinery outside of the data. Nonetheless, the *make* variables were very helpful for explaining used values within the data.

This suggests that no one manufacturer consistently produces what farmers consider the "best" machine. Instead different makes at different times seem to attract the farmer's fancy.

It is interesting to note that the differences between makes increase as a function of time. This is, no doubt, consistent with the need for time to disseminate information about the various makes and models of machinery.

New Models

In only one case, cornpickers, did the effect of new models (as the variable was constructed for this study) appear to be reasonable for all the equations related to a given machine. In certain other cases the introduction of each new model depresses used value of the original model during one of the time spans (1953-1963 or 1958-1963), but not the other.

In one particular case, 1958 model balers, the introduction of several models was reported to slightly increase the value of the original model. All that may be concluded about new models is that refinement of this variable is doubtless a necessity if consistent estimates of the effect of this type of obsolescence are ever to be obtained.

Inflation

The "real" values of farm machinery declined more rapidly, from 0.33% to 1.00% annually of the original value of the machine than their "nominal" values. For example, the "nominal" value of a 1953 forage harvester in 1963 might equal 18.7% of its original cost. The "real" value of this same machine could well be only 11.8%, or 36.8% smaller than the "nominal" value.

Other Variables

Changes in the acreage of crops to be harvested by combines, the amount of corn that might be picked with cornpickers, and the number of livestock to consume chopped or baled forage seemed to have little or no effect on the used values of these machines. (Combined acreage, livestock numbers, and corn acreage were all intercorrelated with age). There also seemed to be no recognizable effect on used values for such technical variations as different attachments for forage harvesters, one-row or two-row cornpickers, wire and twine-tie balers, and pull type as opposed to mounted cornpickers. There were, however, significant differences in "loss-in-value" between pull type and self propelled combines, and gasoline and diesel tractors.

Used tractors of less than thirty horsepower were worth a smaller percentage of their original cost than larger models of the same age. And engine driven machines were often valued at less of their original cost than their PTO counterparts (measured over the ten year period of 1953-1963.)

Estimated Values of Used Farm Machinery

Our previous concepts of machinery "loss-in-value", based on depreciation methods, will need to be revised in line with the information provided by this study. (1) The initial (first year) drop in machinery value tended toward or exceeded the maximum first year depreciation allowed by the Internal Revenue Service. Loss-in-value the first year, depending upon make and machine is apt to be 30% and greater. One estimate, for 1953 cornpicker models, was as high as 47%. (2) Yearly "loss-in- value" (with the exception of the first year) is usually less than assumed with depreciation schedules. (See Table 39, Chapter VIII). (3) The so-called "salvage" value (at ten years of age in "current dollars") was estimated to be roughly two and three times the traditional 10% for self propelled combines and tractors respectively. Estimates of the tenth year value for pull type machines also exceeded the 10% figure, by approximately 5% to 8%. In "constant dollars", a salvage value of 10% is still too small for tractors and self propelled combines, but is a reasonable estimate for pull type harvest machinery. Apparently power units have a longer useful life than the pull type harvesting units.

APPENDIX TABLE A-1--Used values of 1953 model tractors in percent of their new cost (f.o.b. price - 5%)

MAKE	MODEL	H.P.	1954	1955	1956	YEAR 1957	1958	1959	1960	1961	1962	1963
	GASOLINE					PERCENTAGE OF NEW COST						
Allis Chalmers	"B"	20	65.7	58.6	53.2	47.4	53.0	49.9	44.3	38.6	33.7	28.1
	"CA"	23	71.3	58.2	53.7	48.3	54.2	49.8	45.6	42.3	36.2	32.4
	"WD-45"	38	--	62.8	61.6	58.2	55.1	54.8	59.7	52.3	54.7	46.3
Case	"LA"	52	60.2	55.3	55.5	46.6	44.3	41.6	43.5	37.4	37.3	31.3
	"SC"	28	55.2	47.1	41.4	35.4	33.7	36.9	30.8	25.5	27.3	24.1
	"DC"	33	63.3	55.3	55.3	47.4	43.1	39.7	37.1	32.2	30.4	26.0
	"VAC"	16	63.5	50.8	50.8	42.4	36.5	36.8	33.1	29.5	29.5	25.1
Cockshutt	"20"	25	64.7	52.7	44.9	44.6	45.7	49.1	42.0	37.7	33.9	27.7
	"30"	27	64.8	47.2	49.1	50.4	41.5	51.3	46.1	41.3	37.6	31.5
	"40"	38	62.0	50.8	50.3	47.5	44.3	50.9	47.6	42.8	38.3	32.7
John Deere	"40"	22	66.9	57.2	58.7	50.2	46.7	46.6	44.3	48.0	47.0	41.7
	"50"	27	72.9	63.2	63.5	58.4	52.7	55.0	55.2	49.4	47.4	43.7
	"60"	35	77.5	63.4	64.7	60.4	55.5	52.6	60.0	56.7	53.3	49.4
	"70"	42	70.2	66.8	64.3	58.1	60.4	47.8	52.8	59.0	50.5	51.9
Ferguson	"TO-30"	24	70.7	58.7	58.2	51.6	50.0	47.5	46.7	45.2	41.7	41.8
Ford	"NAA"	25	73.7	67.0	65.0	60.8	61.8	53.9	60.3	57.4	59.5	53.3

APPENDIX TABLE A-1 (Cont'd.)

MAKE	MODEL	H.P.	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Farmall	"C"	21	63.3	59.8	51.5	51.0	50.0	47.2	43.3	36.8	35.2	34.7
	"M"	42	69.2	58.1	58.2	51.9	53.4	51.2	50.6	49.8	46.4	47.3
	"H"	31	69.4	60.4	55.2	49.0	45.2	44.0	40.2	39.5	35.3	35.3
	"MD"	42	67.9	58.1	53.6	50.5	44.2	54.1	50.5	53.5	38.3	38.1
	"MTAD"	42	--	--	--	--	--	--	47.9	58.6	42.9	42.4
Massey Harris	"22"	23	65.4	57.2	47.1	40.0	36.3	43.8	40.5	32.4	28.4	25.4
	"33"	36	75.9	56.5	50.3	52.6	42.4	50.7	47.1	38.4	34.1	30.6
	"44"	40	70.7	60.4	56.5	52.2	40.8	51.5	36.4	38.1	34.1	33.4
	"55"	52	61.3	56.4	55.4	50.8	39.8	47.6	45.6	34.1	30.9	33.8
Minneapolis Moline	"BF"	24	61.1	50.9	42.2	44.5	35.8	39.1	36.6	31.7	28.0	23.3
	"GTB"	50	62.1	53.4	45.9	41.0	40.6	43.2	39.8	36.2	32.3	27.6
	"UB"	43	70.1	58.0	55.1	48.3	44.5	45.7	41.5	46.9	43.3	39.5
	"ZB"	32	--	--	--	--	--	39.4	34.8	24.5	22.2	19.2
Oliver	"66"	21	64.3	51.3	47.2	40.9	38.0	41.5	38.4	24.5	21.9	27.1
	"77"	33	69.1	58.4	52.9	48.4	44.4	40.9	40.1	36.9	39.4	38.0
	"88"	37	68.7	59.4	53.0	47.4	44.1	41.6	42.0	38.2	39.7	41.2
	"99"	52	--	54.4	49.2	38.8	41.4	38.5	35.5	33.9	28.6	30.2

APPENDIX TABLE A-1 (Cont'd.)

MAKE	MODEL	H.P.	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
DIESEL												
Cockshutt	"40"	38	60.0	53.0	50.5	49.9	40.8	44.9	41.5	38.6	34.4	28.0
	"30"	27	45.7	--	--	--	48.1	44.1	39.4	38.4	34.5	26.9
John Deere	"70"	45	--	--	--	--	--	--	47.4	46.3	41.4	39.3
Massey Harris	"33"	37	--	--	--	48.2	42.3	47.9	44.3	35.0	31.5	23.9
	"44"	44	59.1	55.6	52.0	46.4	42.6	48.9	41.8	35.1	31.5	25.6
	"55"	52	62.7	54.3	49.4	48.7	40.7	49.1	25.7	34.4	31.3	29.9
Minneapolis Moline	"GTBD"	49	--	52.5	45.0	43.6	40.0	41.4	38.4	34.6	31.8	22.6
	"UBD"	42	53.7	54.7	49.3	42.8	40.3	41.5	37.7	39.8	36.9	31.8
Oliver	"66"	22	60.3	50.3	49.2	31.7	40.4	40.4	37.8	25.1	22.8	21.0
	"77"	31	60.4	52.2	50.4	45.1	42.3	41.0	39.7	36.8	33.7	32.6
	"88"	38	59.9	58.2	52.6	47.1	44.1	41.9	42.7	36.5	36.2	35.2

APPENDIX TABLE A-II--Used values of 1953 combines in percent of their new cost (f.o.b. price-5%)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
PULL TYPE			PERCENTAGE OF NEW COST									
Allis Chalmer	"66"	PTO-6'	--	60.0	53.3	46.1	40.6	37.2	36.0	39.9	35.2	30.0
Case	"A"	PTO-6'	67.9	63.1	52.2	40.9	34.0	31.7	27.8	30.1	23.3	19.2
	"K-2"	ED-12'	57.4	49.5	42.6	36.5	33.5	28.6	23.0	18.4	--	--
John Deere	"25"	PTO-6'	--	70.8	54.8	44.9	38.2	38.2	32.8	32.7	34.4	24.1
	"65"	ED-12	72.7	59.1	52.0	45.7	47.2	42.8	40.7	36.2	26.9	22.8
Ford	"16-37"	PTO-6'	62.7	50.5	45.8	38.2	34.9	29.1	29.6	26.0	20.3	20.0
Gleaner Baldwin	"S"	PTO-6'	47.3	44.8	39.1	34.0	29.2	26.6	27.3	27.5	--	--
	"E"	ED-12'	55.7	--	46.0	40.1	36.0	25.3	21.4	17.9	--	--
International Harvester	"62"	PTO-6'	64.6	69.5	45.5	39.6	37.4	34.5	31.4	27.5	--	--
	"122"	ED-12'	65.1	46.4	43.3	36.7	34.4	32.5	27.7	24.6	--	--
Massey Harris	"Clipper"	PTO-6	65.4	54.7	47.8	41.4	37.1	39.1	36.2	23.2	18.6	15.3
Minneapolis Moline	"G-4"	ED-12'	56.9	52.3	45.3	40.9	37.4	32.5	27.2	23.6	--	--
Oliver	"15"	PTO-6'	65.1	54.9	50.0	41.9	36.8	34.8	37.2	30.2	19.6	15.4
	"30"	ED-12	60.1	49.8	43.3	37.3	33.1	33.5	28.3	24.6	--	--

APPENDIX TABLE A-II (cont'd.)

MAKE	MODEL	TYPE	YEAR 1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
SELF PROPELLED												
Allis Chalmers	"100"	9'6"	--	56.4	50.3	42.3	45.5	44.6	42.2	36.0	26.4	21.7
Case	"SP-9"	9'	58.0	49.7	43.5	37.9	35.0	32.5	28.3	24.9	16.5	14.4
	"SP-12"	12'	58.2	50.0	43.7	39.1	37.0	32.0	27.8	25.5	19.0	17.3
John Deere	"55"	12'	72.6	60.5	48.7	44.6	43.9	42.5	48.0	46.2	39.9	39.2
Gleaner Baldwin	"14"	14'	64.5	55.4	49.2	43.9	39.7	34.7	29.8	27.4	15.9	13.0
International Harvester	"127SP"	10'	60.5	53.5	47.9	41.3	38.2	31.7	39.3	30.9	23.5	23.7
Massey Harris	"70"	8'6"	62.2	55.6	48.4	41.0	36.0	32.4	39.8	37.8	30.6	25.5
	"80"	10'	60.7	57.5	50.0	45.0	41.3	38.7	43.8	41.8	29.9	35.4
	"90"	12'	61.8	55.6	48.9	54.8	40.1	38.2	44.4	41.8	32.9	39.6
Minneapolis Moline	"S"	12'	57.5	55.4	48.1	41.1	36.8	17.0	29.4	25.8	20.4	16.7
Oliver	"33"	12'	57.0	51.7	44.6	38.8	38.2	33.8	38.6	36.6	27.0	27.4

Where: ED is engine driven, PTO is power take off, and 6', 9'----14' indicate header width.

APPENDIX TABLE A-III--Used values for 1953 model forage harvesters in percent of their new cost (f.o.b. -5%)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
			PERCENTAGE OF NEW COST									
Allis Chalmers	--	PTO-Pu	61.9	53.0	47.2	42.5	34.1	43.1	37.7	30.6	26.6	19.6
		PTO-Rc	60.2	51.7	41.7	40.8	37.1	41.5	36.3	29.7	25.8	19.2
		ED-Pu	60.5	52.6	46.5	41.5	37.5	40.9	35.9	29.3	--	--
		ED-Rc	60.4	52.3	46.3	41.0	37.4	40.6	35.8	29.3	--	--
Case	"C & C2"	PTO-Rc	56.2	50.9	45.4	39.1	34.9	29.2	29.9	22.7	20.6	16.7
		PTO-Cb	61.7	57.5	49.8	42.9	38.3	35.4	33.2	24.8	22.4	18.2
		ED-Rc	57.2	52.6	46.4	41.0	35.9	31.7	25.7	25.7	--	--
		ED-Cb	60.8	57.0	49.3	43.6	38.1	37.8	27.7	27.1	--	--
John Deere	"72 & 74'	PTO-Pu	60.3	51.9	46.9	42.2	37.8	28.4	28.2	23.2	19.8	15.8
		PTO-Rc	60.1	52.5	46.8	42.1	38.0	29.9	29.8	24.6	17.0	16.6
		ED-Pu	60.1	51.8	47.3	42.6	38.1	28.4	28.5	25.0	--	--
		ED-Rc	60.0	52.2	47.1	42.4	38.3	29.5	29.6	25.8	--	--
Fox	"54 & 56"	PTO-Cb	59.1	54.3	53.5	42.5	37.8	37.3	32.8	30.5	25.5	21.5
		PTO-Rc	62.3	55.6	47.9	43.0	38.4	37.0	32.6	30.2	24.9	20.9
		ED-Cb	59.9	51.5	51.7	42.3	37.9	37.1	33.2	30.2	--	--
		ED-Rc	61.7	51.9	47.2	42.3	38.0	36.6	32.4	29.7	--	--

APPENDIX TABLE A-III (cont'd.)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Gehl	--	PTO-Rc	59.2	50.9	48.8	43.7	40.2	47.2	44.2	31.7	28.3	25.9
		PTO-Cb	60.7	51.7	48.5	43.2	40.1	47.6	44.2	36.8	28.8	26.3
		ED-Rc	59.0	53.0	49.2	43.9	40.4	40.2	40.3	29.7	--	--
		ED-Cb	60.0	53.4	49.0	43.5	40.3	40.8	40.5	33.2	--	--
International Harvester	"20 - C"	PTO-Pu	62.5	75.9	48.6	43.9	37.7	42.3	35.2	32.9	27.1	23.4
		PTO-Rc	62.9	73.9	49.3	43.6	35.3	40.0	33.2	31.0	25.8	22.2
		ED-Pu	60.1	52.1	49.2	43.6	38.3	40.6	33.1	31.1	--	--
		ED-Rc	60.5	51.9	49.1	43.4	36.8	39.3	32.0	30.0	--	--
Massey Harris	"20"	PTO-HT	55.9	49.4	47.0	39.7	36.1	35.6	31.8	26.2	20.7	15.5
		PTO-CT	58.2	51.3	47.2	41.9	36.6	36.1	31.6	26.3	21.5	16.4
		ED-HT	51.8	48.2	46.0	39.9	36.6	37.0	32.5	26.8	--	--
		ED-CT	52.6	48.7	45.2	39.2	36.0	36.4	32.2	26.8	--	--
New Holland	"600&610"	PTO-Rc	56.2	54.7	49.6	42.1	36.0	31.7	26.8	21.6	17.6	13.0
		PTO-Cb	56.8	54.5	47.2	41.7	35.9	31.7	27.5	22.0	18.1	13.5
		ED-Rc	61.3	55.3	48.2	41.3	36.0	33.7	27.7	23.2	--	--
		ED-Cb	61.7	55.2	47.0	41.0	35.9	33.7	28.2	23.4	--	--

APPENDIX TABLE A-III (cont'd.)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Papec	"151D"	PTO-Rc	60.0	57.6	45.1	39.7	36.1	34.7	32.9	27.4	22.4	19.3
		PTO-Cb	59.9	57.4	44.8	39.6	36.3	39.7	38.1	30.0	26.1	22.5
		ED-Rc	58.3	51.2	46.1	40.1	36.2	35.0	34.7	29.1	--	--
		ED-Cb	58.3	51.1	45.9	40.0	36.3	41.3	38.0	30.8	--	--

Where: EDis engine driven, PTO is power takeoff, Pu indicates pickup attachment, Cb indicates cutterbar attachment, Rc indicates rowcrop attachment----HT and CT refer to "hay table" and "corn table" for Massey Harris only.

APPENDIX TABLE A-IV--Used values for 1953 model hay balers in percent of their new cost (f.o.b. - 5%)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
						PERCENTAGE OF NEW COST						
Allis Chalmers	"ROTO"	PTO-T	70.2	62.4	54.3	48.6	45.6	48.3	41.8	33.5	32.1	24.7
	"ROTO"	ED-T	69.4	60.6	53.5	46.7	43.5	48.8	43.4	34.2	22.7	17.5
Case	"NCM-T"	ED-T	57.3	48.1	41.6	36.1	32.3	17.6	14.4	12.4	--	7.7
John Deere	"114&116W"	PTO-W	67.0	54.3	47.9	40.3	35.6	30.1	25.3	23.0	17.9	15.0
	"114&116W"	ED-W	66.4	48.2	45.1	41.3	38.2	31.3	26.3	20.9	14.1	11.8
International Harvester	"45-T"	PTO-T	74.0	76.4	51.8	46.6	42.9	40.7	34.5	29.2	25.1	23.4
	"50-T"	ED-T	56.9	32.8	40.3	35.4	32.6	27.8	23.3	20.1	14.6	11.5
Massey Harris	"1"	ED-T	55.7	38.2	45.0	46.6	43.8	35.5	33.5	29.7	19.3	16.5
Minneapolis Moline	"Baleomatic"	ED-W	54.3	40.7	46.2	41.3	36.4	34.6	29.0	25.7	16.2	13.2
New Holland	"77"	ED-T	71.1	59.1	51.1	44.2	38.9	34.5	30.1	26.3	12.5	11.6
	"80"	ED-W	72.6	55.2	49.0	42.7	37.6	32.5	27.1	23.6	16.7	11.8
Oliver	"8"	ED-W	68.0	49.4	43.4	37.6	33.5	29.0	20.9	20.5	6.6	9.4

Where : ED is engine driven, PTO is power take off, T is twine tie, and W is wire tie.

APPENDIX TABLE A-V--Used values for 1953 model corn pickers in percent of their new cost (f.o.b. - 5%)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
				PERCENTAGE OF NEW COST								
Allis Chalmers	"WD"	Mtd - 2	65.2	52.8	45.8	40.0	41.3	49.7	47.5	41.3	36.5	29.9
	"Pull-Type"	Pt - 1	62.8	50.9	41.2	34.8	37.4	42.9	38.5	31.0	25.5	21.0
Case	"IR"	Pt - 2	54.2	33.9	30.3	26.2	23.3	16.9	15.6	13.2	5.3	6.1
	"PR"	Pt - 1	70.1	39.6	43.2	39.4	33.3	34.1	32.9	24.7	24.9	22.8
Ford	"16-4"	Pt - 1	68.5	52.4	45.0	41.6	37.0	37.0	37.2	28.8	25.0	22.2
Ferguson	"EH-H"	Pt - 1	59.8	51.0	44.5	38.0	33.1	30.0	24.5	20.6	8.0	5.2
John Deere	"200"	Pt - 2	64.7	41.4	36.2	30.7	25.1	23.2	21.2	17.7	13.7	9.4
	"226"	Mtd - 2	55.2	39.1	34.5	29.7	27.0	30.0	27.0	16.8	12.1	7.2
International	"14-P"	Pt-1	65.2	48.9	40.0	33.5	28.8	36.9	30.7	25.1	19.5	17.4
Harvester	"24"	Mtd - 2	61.4	47.0	42.9	37.1	32.2	30.9	26.2	19.3	8.6	6.8
		Pt - 1	65.2	48.9	40.0	33.5	28.8	36.9	30.7	25.1	19.5	17.4
Massey Harris	"30-44"	Mtd - 2	53.3	48.4	41.7	39.9	35.9	34.2	29.9	24.5	14.2	10.2
Minneapolis Moline	"Husker"	Pt - 1	61.6	42.1	45.0	42.7	37.4	37.6	35.6	30.6	26.0	22.9
	"Husker"	Pt - 2	57.8	42.4	44.4	41.1	38.0	38.7	40.5	35.3	29.8	29.4
New Idea	"6"	Pt - 2	61.7	46.9	42.2	35.7	32.6	34.5	29.1	34.0	22.3	15.9
	"7"	Pt - 1	69.8	52.4	47.5	40.6	35.7	33.3	28.1	23.2	17.7	20.3

APPENDIX TABLE A-V (cont'd.)

MAKE	MODEL	TYPE	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Oliver	"2"	Pt - 2	54.8	42.7	44.3	38.8	36.3	31.8	27.0	22.1	16.2	6.0
	"4"	Mtd.-2	54.3	44.7	45.2	41.3	39.7	42.0	38.8	34.6	31.2	33.2
	"5"	Pt - 1	64.8	51.2	45.3	38.5	40.0	35.8	32.2	27.7	25.3	26.0

Where: Mtd is mounted, Pt is pull type, and 1 or 2 indicates the number of rows harvested.

APPENDIX TABLE B-1--Used values of 1958 model tractors in percent of their new cost (f.o.b. price - 5%)

MAKE	MODEL	H.P.	YEAR 1959	1960	1961	1962	1963
	GASOLINE		PERCENTAGE OF NEW COST				
Allis Chalmers	"B"	21	66.6	59.2	53.2	41.7	36.3
	"CA"	24	65.5	60.4	53.3	45.5	40.8
	"D-14"	32	69.5	67.8	64.7	61.0	57.1
	"D-17"	48	68.6	65.4	65.6	64.8	60.5
	"WD-45"	40	67.9	68.1	59.9	60.1	55.2
Case	"211B"	26	--	77.8	71.2	64.8	59.4
	"300B"	31	--	72.2	65.9	61.4	56.4
	"400 Case-o-matic"	31	--	71.7	65.0	62.2	57.7
	"511B"	41	--	76.0	69.7	65.7	60.3
	"611B Case-o-matic"	38	--	75.6	67.8	62.5	58.0
	"711"	48	--	68.8	63.2	61.3	59.8
	"811 Case-o-matic"	50	--	69.3	65.7	59.5	56.3
Cockshutt	"20"	27	77.8	67.5	60.4	51.7	45.3
	"35"	--	77.5	70.6	64.9	57.9	50.7
	"40"	40	75.8	70.7	63.5	57.5	49.6
	"50"	52	75.3	70.6	63.5	57.9	49.8

APPENDIX TABLE B-I (cont'd.)

MAKE	MODEL	H.P.	1959	1960	1961	1962	1963
John Deere	"320"	--	66.3	62.1	55.6	50.8	46.1
	"420"	26	67.3	63.2	65.7	64.5	60.4
	"520"	33	70.3	63.8	58.2	53.0	53.1
	"620"	42	72.6	70.3	62.8	57.1	59.1
	"720"	53	74.7	69.5	67.2	63.6	58.5
Ferguson	"35"	32	--	--	61.0	59.7	55.1
Ford	"641"	31	--	67.0	65.5	63.2	59.8
	"741"	29	--	66.1	63.9	59.8	55.4
	"841"	42	--	67.7	63.6	62.1	61.1
	"951"	41	--	65.0	60.3	55.4	57.0
International Harvester	"130"	21	66.3	62.1	60.5	57.4	59.8
	"230"	26	67.1	61.1	56.3	53.2	56.3
	"350"	39	76.6	68.3	57.3	53.0	51.4
	"450"	51	78.3	66.9	59.6	56.8	58.1
	"350U"	41	72.2	68.1	61.6	62.7	53.9
	"W-450"	51	72.2	64.2	58.9	53.9	55.5
	"650"	58	76.8	68.7	63.2	57.8	55.2
Massey Harris	"50"	32	69.1	66.4	63.4	60.0	52.9
	"333"	39	76.8	69.6	63.7	58.3	55.6
	"444"	45	74.6	67.4	61.5	56.1	55.2
	"555"	60	75.6	70.2	64.6	58.4	58.0

APPENDIX TABLE B-I (cont'd.)

MAKE	MODEL	H.P.	1959	1960	1961	1962	1963
Minneapolis Moline	"335"	31	66.5	54.4	49.6	45.9	47.6
	"335U"	29	70.8	57.9	52.8	48.8	50.7
	"445"	41	72.6	59.5	55.6	50.7	49.6
	"550"	--	68.4	67.6	62.1	56.4	51.7
	"GB"	62	65.7	64.7	59.8	54.3	52.6
	"UB Spec 42"	45	59.3	--	--	--	--
Oliver	Super "44"	--	62.8	58.5	53.8	48.7	51.2
	Super "55"	31	64.5	58.3	51.9	46.9	48.3
	"550"	33	64.0	51.6	52.4	47.6	41.9
	Super "66"	30	66.9	64.7	57.3	46.8	53.1
	Super "77"	40	68.7	63.5	57.9	52.3	46.8
	Super "88"	50	68.4	64.1	58.0	52.7	50.2
	"99"	--	67.5	58.0	56.2	51.7	48.9
DIESEL							
Allis Chalmers	"D-17"	47	66.8	64.8	61.6	59.6	52.2
	"WD-45	40	66.6	63.7	57.1	56.4	48.1
Case	"300B"	29	--	69.8	63.2	59.5	50.5
	"701"	47	--	67.2	64.0	59.8	54.8
	"801 Case-o-matic"	53	--	67.8	60.4	56.0	53.2

APPENDIX TABLE B-I (cont'd.)

MAKE	MODEL	H.P.	1959	1960	1961	1962	1963
Cockshutt	"40"	40	73.4	67.4	63.1	56.5	44.6
	"Golden Eagle"	--	74.6	69.7	63.9	58.2	50.7
	"50"	47	72.2	67.0	60.8	54.5	43.3
John Deere	"720"	52	74.9	67.7	64.5	55.3	53.7
Ford	"FMD-12"	36	73.7	66.8	62.7	53.4	49.2
International Harvester	"350"	37	74.6	66.9	56.9	51.1	49.3
	"450"	46	74.1	62.6	58.3	51.5	52.6
	"650"	--	74.4	65.9	61.6	56.2	45.1
Massey Harris	"333"	33	74.0	66.7	61.1	55.5	56.1
	"444"	44	73.4	66.3	61.2	56.1	48.6
Minneapolis Moline	"GB-55"	58	66.1	66.0	59.3	52.6	47.1
	"UB"	--	60.2	--	--	--	--
Oliver	"66"	27	66.6	63.2	57.4	53.1	48.6
	"77"	40	67.5	63.1	57.4	52.3	42.7
	"88"	50	67.8	62.5	56.9	51.9	47.8
	"99"	61	67.1	62.4	57.2	53.4	45.9
	"99GM"	77	--	--	57.3	52.6	--

APPENDIX TABLE B-II Used values of 1958 model combines in percent of their new cost (f.o.b.price -5 %)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
PULL TYPE			PERCENTAGE OF NEW COST				
Allis Chalmers	"66" Big Bin	6'PTO	65.1	62.5	57.1	46.5	36.1
	"66" Big Bin	6' ED	65.0	62.9	58.0	--	--
	"90"	7 1/2' PTO	62.2	64.9	57.4	46.0	35.3
Case	"55"	5' PTO	66.3	56.3	51.6	33.7	21.3
	"65"	6' PTO	67.7	60.6	53.7	40.7	29.1
	"65	6' ED	64.6	55.8	48.0	--	--
	"75"	7' PTO	--	59.0	50.0	38.4	27.3
	"75"	7' ED	66.7	57.7	54.3	--	--
	"77"	7' PTO	64.9	65.4	58.3	50.5	32.9
	"77"	7' ED	67.7	63.2	58.5	--	--
	"110"	9' ED	66.1	57.2	52.8	40.4	25.8
Cockshutt	"422"	6' PTO	64.3	62.5	56.4	47.6	40.3
John Deere	"30"	7' PTO	65.5	61.2	56.2	48.8	44.6
	"30"	7' ED	64.6	60.6	53.7	--	--
Ford	"16-46 & 48"	6' ED	65.9	60.9	58.3	--	--
	"16-47 & 49"	6' PTO	66.1	61.6	60.0	46.2	39.6
	"16-98 & 100"	7' ED	59.37	60.6	53.7	--	--
	"16-99 & 101"	7' PTO	61.7	61.3	61.4	44.7	39.0

APPENDIX TABLE B-II (Cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
International Harvester	"76"	7'ED	59.7	57.0	51.8	--	--
	"76"	7'PTO	61.0	59.5	53.3	38.3	34.2
	"140"	9'ED	64.1	60.1	54.2	--	--
	"140"	9'PTO	64.7	61.4	54.7	47.9	51.7
Massey Ferguson	"60PT"	8'ED	64.5	53.3	47.4	--	--
	"60PT"	8'PTO	64.4	55.7	49.6	37.3	33.1
	"50 Clipper"	6'PTO	65.1	60.8	53.0	45.4	35.9
	"50 Clipper"	6'ED	65.0	58.0	50.4	--	--
	"50 Clipper"	7' PTO	63.9	63.3	54.9	43.4	34.2
	"50 Clipper"	7' ED	68.5	61.8	57.7	--	--
Minneapolis Moline	"G-144"	12'ED	63.3	60.4	54.0	32.0	24.4
	"88"	7' PTO	66.0	60.4	52.8	43.4	37.7
	"88"	7'Ed	65.4	60.4	54.4	--	--
Oliver	"18"	7'PTO	63.1	58.7	54.7	48.7	45.7
	"18"	7' ED	62.1	57.5	56.0	--	--
SELF PROPELLED							
Allis Chalmers	"Super 100"	9'	62.1	59.0	54.1	42.9	35.2
	"T-2"	7'	65.4	56.4	50.9	40.1	33.3
	"T-3"	9'9"	63.9	55.1	49.7	39.1	32.5
	"A"	10'-12'-14'	62.7	61.1	55.5	46.6	43.2

APPENDIX TABLE B-II (cont'd.)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Case	"150"	10'	75.2	69.2	66.2	51.1	34.9
Cockshutt	"427"	12'	62.8	55.7	45.5	43.1	36.2
	"428"	12'	63.2	63.3	60.2	50.3	46.7
John Deere	"45"	8'-10'	63.2	61.8	60.7	46.7	48.8
	"55"	12'-14'	62.6	63.4	61.2	57.4	46.7
	"95"	14'-18'	--	--	59.2	51.8	53.6
International Harvester	"101"	10'	62.1	62.3	58.4	53.4	50.1
	"141"	10'	63.4	59.7	54.8	44.2	39.8
	"151"	15'	--	62.0	56.7	50.7	49.4
Massey Ferguson	"60"	10'	62.6	58.0	51.3	46.3	38.5
	"82"	10'	61.5	64.6	57.3	48.2	50.3
	"92"	12'	61.2	64.6	57.9	50.9	50.4
Minneapolis Moline	"SP-168"	12'	61.3	61.4	55.1	43.2	38.2
	"SPR-168"	13'	55.3	55.4	49.6	38.9	34.4
Oliver	"35"	10'	61.8	59.5	57.2	47.2	46.1

Where: ED is engine driven, PTO is power takeoff and 5'6'----18' refers to the width of the header.

APPENDIX TABLE B-III--Used values of 1958 model forage harvestors in percent of their new cost (f.o.b.- 5%)

MAKE	MODEL	TYPE	YEAR 1959	1960	1961	1962	1963
			PERCENTAGE OF NEW COST				
Allis Chalmers	--	PTO-Cb&Ru	70.3	58.9	43.1	39.4	35.3
	--	PTO-Rc	69.5	61.7	44.9	41.4	37.2
	--	ED-Cb&Pu	68.1	60.0	44.5	--	--
	--	ED-Rc	67.5	62.1	45.9	--	--
Case	"211"	PTO-Pu	--	51.6	45.8	41.0	36.5
	"211"	PTO-Rc	--	52.5	48.7	41.2	37.2
	"211"	PTO-Cb	--	52.7	46.6	40.5	40.5
	"212"	PTO-Pu	--	47.3	42.0	37.6	33.5
	"212"	PTO-Rc	--	48.3	44.8	37.9	34.2
	"212"	PTO-Cb	--	48.9	43.2	37.6	33.7
	"220"	PTO-Pu	62.7	61.1	47.7	40.9	34.6
	"220"	PTO-Rc	62.5	61.0	47.5	41.0	34.8
	"220"	PTO-Cb	62.5	59.8	46.7	39.9	34.1
	"225"	ED-Pu	62.8	43.3	34.0	--	--
	"225"	ED-Rc	62.7	43.7	34.3	--	--
	"225"	ED-Cb	62.6	44.1	34.7	--	--

APPENDIX TABLE B-III (Cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Cockshutt	"411"	PTO-Pu	59.9	45.4	41.7	30.7	25.5
	"411"	PTO-Rc	59.8	44.6	41.8	29.7	24.5
	"411"	PTO-Cb	59.4	44.6	40.9	32.6	27.7
	"411"	ED-Pu	60.5	46.0	42.2	--	--
	"411"	ED-Cb	60.1	46.3	42.7	--	--
	"411"	ED-Rc	60.3	46.8	43.1	--	--
John Deere	"8"	PTO-Pu	65.2	55.6	42.6	38.9	34.4
	"8"	PTO-Rc	63.1	54.9	41.1	37.4	32.7
	"8"	PTO-Cb	63.0	55.8	41.5	37.8	33.2
	"8"	ED-Pu	68.6	54.1	42.1	--	--
	"8"	ED-Rc	69.0	54.1	41.3	--	--
	"8"	ED-Cb	68.6	54.4	41.3	--	--
Ford	"14-137"	PTO-Pu	65.6	63.5	51.4	42.9	33.4
	"14-137"	PTO-Rc	65.4	65.5	54.0	45.2	35.3
	"14-137"	PTO-Cb	67.4	66.3	66.3	44.2	35.0
	"14-137"	ED-Pu	65.4	62.6	50.1	--	--
	"14-137"	ED-Rc	65.6	64.4	52.2	--	--
	"14-137"	ED-Cb	65.4	63.5	50.1	--	--

APPENDIX TABLE B-III (cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Fox	"544"	PTO-Pu	65.4	59.5	49.3	40.1	34.8
	"544"	PTO-Rc	65.4	59.1	49.3	39.9	45.2
	"544"	PTO-Cb	65.5	59.8	49.7	40.8	35.1
	"544"	ED-Pu	65.7	59.0	49.0	--	--
	"544"	ED-Rc	65.7	58.8	49.0	--	--
	"544"	ED-Cb	65.7	59.3	49.3	--	--
	"1F546"	PTO-Pu	65.3	59.2	45.0	40.0	37.2
	"1F546"	PTO-Rc-1	65.3	58.5	45.2	40.2	37.4
	"1F546"	PTO-Rc-2	65.3	59.1	45.4	--	37.4
	"1F546"	PTO-Cb-6'	65.3	58.4	43.7	40.3	37.1
	"1F546"	PTO-Cb-7'	65.3	58.4	--	--	--
	"1F546"	ED-Pu	65.2	57.8	44.8	--	--
	"1F546"	ED-Bc-1	65.2	57.4	44.2	--	--
	"1F546"	ED-Rc-2	65.2	57.9	45.1	--	--
	"1F546"	ED-Cb-6'	65.2	56.3	44.0	--	--
	"1F546"	ED-Cb-7'	65.2	57.5	--	--	--

APPENDIX B-III (cont'd.)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Gehl	--	PTO-Pu	65.7	60.3	48.3	43.8	39.9
	--	PTO-Rc	65.5	59.9	49.0	41.8	38.1
	--	PTO-Cb	67.9	62.2	52.1	43.7	40.1
	--	ED-Rc	60.6	58.9	47.8	--	--
	--	ED-Cb	62.5	60.6	50.0	--	--
	--	ED-Pu	60.4	59.0	47.3	--	--
International Harvester	"20-C"	PTO-Ru	68.2	62.0	52.3	47.0	40.1
	"20-C"	PTO-Rc	65.3	59.6	50.2	45.4	38.4
	"20-C"	PTO-Cb	65.3	59.0	50.4	45.2	38.2
	"20-C"	ED-Pu	67.1	59.6	50.7	--	--
	"20-C"	ED-Rc	65.2	58.2	49.4	--	--
	"20-C"	ED-Cb	65.3	57.9	49.6	--	--
Massey Ferguson	"20"	PTO-Pu&Cb	61.0	56.2	46.8	39.6	29.3
	"20"	PTO-Rc	64.4	56.1	46.5	40.9	30.7
	"20"	ED-Pu&Cb	64.6	55.7	46.4	--	--
	"20"	ED-Rc	65.6	57.1	47.1	--	--

APPENDIX TABLE B-III (cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
New Holland	"611"	PTO-Pu	72.0	64.9	49.3	42.9	36.0
	"611"	PTO-Rc	69.7	62.4	49.2	42.8	36.1
	"611"	PTO-Cb	69.7	62.9	49.3	42.8	35.9
	"601"	ED-Pu	72.6	65.2	49.5	--	--
	"601"	ED-Rc	70.9	63.4	49.5	--	--
	"601"	ED-Cb	71.0	63.7	49.5	--	--
	"800"	PTO-Pu	--	64.3	49.2	46.3	41.4
	"800"	PTO-Rc	--	64.0	49.2	46.3	41.3
	"800"	PTO-Cb	--	64.5	49.2	46.3	41.4
	"800"	ED-Pu	--	63.3	49.2	--	--
	"800"	ED-Rc	--	63.2	49.2	--	--
	"800"	ED-Cb	--	63.5	49.3	--	--
Oliver	"200"	PTO-Rc	67.2	61.9	46.7	40.7	34.3
	"200"	PTO-Pu	75.8	69.9	53.1	46.1	39.3
Papec	"32"	PTO-Pu	66.6	59.2	44.6	39.4	32.6
	"32"	PTO-Rc	67.2	59.3	45.1	39.7	33.1
	"32"	PTO-Cb	66.7	59.5	44.7	39.5	32.4
	"32"	ED-Pu	65.6	--	44.2	--	--
	"32"	ED-Rc	65.7	--	44.3	--	--
	"32"	ED-Cb	65.6	--	44.2	--	--

APPENDIX TABLE B-III (cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Papec	"92"	PTO-Pu	65.4	59.3	45.4	47.4	41.7
	"92"	PTO-Rc	65.4	58.9	45.4	48.0	42.5
	"92"	PTO-Cb	65.4	59.2	45.6	46.0	40.5
	"92"	ED-Pu	63.3	55.8	43.5	--	--
	"92"	ED-Rc	65.4	57.4	44.9	--	--
	"92"	ED-Cb	65.4	57.8	45.1	--	--

Where: ED is engine driven, PTO is power takeoff, Pu indicates pickup attachment, Rc indicates row crop attachment, and Cb indicates cutterbar attachment.

APPENDIX TABLE B-IV--Used values of 1958 model balers in percent of their new cost (f.o.b. price - 5%)

MAKE	MODEL	TYPE	YEAR 1959	1960	1961	1962	1963
			PERCENTAGE OF NEW COST				
Allis Chalmers	"ROTO"	PTO-T	68.5	60.8	49.0	47.1	37.8
	"ROTO"	ED-T	69.5	61.9	49.0	--	--
Case	"133"	ED-T	66.9	59.6	38.5	--	--
	"133"	PTO-T	68.6	59.3	43.1	37.6	31.6
	"140W"	ED-W	--	60.7	31.6	--	--
	"140W"	PTO-W	--	61.0	30.1	27.7	26.2
	"160T"	ED-T	--	56.0	41.9	--	--
	"160T"	PTO-T	--	56.6	42.2	31.9	29.6
	"160W"	ED-W	--	57.8	43.0	--	--
	"160W"	PTO-W	--	58.3	43.7	32.2	29.8
	"135"	ED-W	--	56.1	35.0	--	--
	"135"	PTO-W	--	54.4	35.1	32.7	26.5
John Deere	"14-T"	PTO-T	63.4	56.8	51.8	43.7	46.9
	"14-T"	ED-T	62.9	56.0	49.8	--	--
	"214-T"	PTO-T	66.4	50.2	50.0	40.6	42.5
	"214-T"	ED-T	66.9	56.2	49.6	--	--
	"214-W"	PTO-W	67.0	56.2	43.9	33.6	34.1
	"214-W"	ED-W	67.3	55.8	43.7	--	--

APPENDIX TABLE B-IV (cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Ferguson	"F-12"	PTO-T	65.1	54.2	47.4	26.3	17.9
	"F-12"	ED-T	67.8	54.6	47.2	--	--
Ford	"14-49"	ED-T	67.1	56.6	47.2	--	--
	"250" "14-71"	ED-T	67.3	61.4	57.6	--	--
	"250" "14-80"	PTO-T	67.7	63.9	60.8	43.4	40.6
International Harvester	"45-T"	PTO-T	67.4	55.0	49.0	35.6	33.2
	"45-T"	ED-T	67.4	54.2	48.3	--	--
	"46-T"	PTO-T	68.2	58.9	52.3	43.7	43.9
	"46-T"	ED-T	64.6	54.3	46.5	--	--
	"55-T"	PTO-T	67.0	54.3	45.0	35.2	35.9
	"55-T"	ED-T	67.2	53.0	45.4	--	--
	"55-W"	PTO-W	66.8	49.8	43.6	39.7	38.7
	"55-W"	ED-W	66.5	50.8	43.9	--	--
Massey Harris	"1"	ED-T	66.4	52.9	46.8	--	--
	"1"	PTO-T	66.0	52.5	46.0	37.7	32.0
	"3"	ED-T	69.2	60.2	44.4	--	--
	"3"	PTO-T	69.1	61.4	42.2	41.5	40.5
Minneapolis Moline	"Pull type"	PTO-T	70.4	59.7	50.3	38.0	33.2

APPENDIX TABLE B-IV (cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
New Holland	"Super 66"	PTO-T	67.6	56.5	49.7	46.9	49.2
	"Super 66"	ED-T	66.9	57.0	50.5	--	--
	"68"	ED-T	66.9	56.4	49.5	--	--
	"68"	PTO-T	66.6	57.9	48.3	50.9	50.7
	"Super 77"	ED-T	64.2	55.7	49.3	--	--
	"Super 77"	PTO-T	66.6	57.2	50.3	45.0	35.1
	"87"	ED-W	71.9	56.0	49.8	--	--
	"87"	PTO-W	67.2	54.8	48.1	34.7	25.0
	"98"	ED-W	66.9	59.6	45.6	--	--
Oliver	"60"	PTO-T	64.5	58.8	44.2	40.5	39.4
	"60"	ED-T	64.7	58.7	44.1	--	--
	"100"	ED-W	65.8	53.1	46.9	--	--
	"60-W"	ED-W	--	58.7	45.9	--	--
	"60-W"	PTO-W	--	57.1	45.1	38.6	29.3

Where: ED is engine driven, PTO is power takeoff, T is for twine tie, and W is for wire tie.

APPENDIX TABLE B-V--Used values of 1958 model corn pickers in percent of their new cost (f.o.b. price - 5%)

MAKE	MODEL	TYPE	YEAR 1959	1960	1961	1962	1963
			PERCENTAGE OF NEW COST				
Allis Chalmers	"33"	Mtd. - 2	64.4	61.6	53.5	48.3	41.9
	"35"	Pt - 1	66.0	60.5	48.1	40.8	35.2
	"17"	Mtd - 2	--	64.3	54.2	46.6	39.4
Case	"P"	Pt - 1	64.5	69.0	50.6	54.3	47.2
	"PR"	Pt - 1	65.0	65.3	49.8	50.2	44.8
	"420"	Mtd - 2	60.1	56.2	44.8	29.5	21.0
	"425"	Mtd - 2	--	69.8	56.5	48.2	41.2
John Deere	"127"	Mtd - 1	63.0	69.1	51.8	42.9	38.5
	"227"	Mtd - 2	63.5	62.2	57.7	52.1	49.7
Ford	"16-4"	Pt - 1	63.8	64.4	50.5	44.2	38.4
	"16-65"	Mtd - 1	63.6	68.2	53.4	50.3	44.5
	"16-66"	Mtd - 2	63.6	68.9	64.7	49.9	46.7
International Harvester	"1-PR"	Pt - 1	64.9	61.4	49.4	44.2	39.3
	"2-PR"	Pt - 2	63.4	62.5	52.2	49.3	45.0
	"2C-10"	Mtd -1	64.8	--	44.0	34.9	24.8
	"34 HM-20"	Mtd -2	64.6	58.4	47.3	42.5	29.5
Massey Ferguson	"1"	Pt - 1	54.5	45.8	37.3	25.4	18.1
	"333 & 444"	Mtd.-2	62.7	54.5	45.9	27.6	20.6

APPENDIX TABLE B-V (cont'd)

MAKE	MODEL	TYPE	1959	1960	1961	1962	1963
Minneapolis Moline	--	Pt - 1	62.2	59.5	51.2	44.1	39.4
	--	Pt - 2	60.9	58.1	55.4	47.5	48.0
	--	Mtd - 2	59.4	58.7	48.6	40.1	32.7
New Idea	"6 & 6A"	Pt - 2	60.9	51.1	46.5	40.1	29.4
	"10"	Pt - 1	62.1	60.3	46.2	48.0	37.0
	"300"	Pt - 2	60.5	45.7	49.7	44.6	40.3
	"20"	Mtd - 2	61.9	54.4	45.4	32.6	23.5
Oliver	"3"	Pt - 2	61.3	57.8	48.4	39.6	27.2
	"4"	Mtd - 2	61.8	57.7	51.3	46.5	46.7
	"5"	Pt - 1	62.5	57.2	48.1	44.5	43.1
	"6"	Mtd - 1	62.6	57.7	50.2	35.7	27.5

Where: Mtd refers to mounted, Pt is pull type, and 1 or 2 indicates the number of rows harvested.

APPENDIX TABLE C-I--Used values of selected 1956 machines in percent of their new cost (f.o.b. price - 5%)

MAKE	MODEL	OTHER	1957	1958	1959	YEAR 1960	1961	1962	1963	1964	1965	1966
						PERCENT						
GASOLINE TRACTORS												
Allis Chalmers	"WD-45"	38	69.7	67.1	64.6	66.9	58.7	59.9	53.2	54.1	49.8	46.0
Case	"411"	44	--	63.1	58.8	55.8	53.3	50.4	50.9	47.0	42.3	38.4
Ford	"850"	39	67.8	69.0	63.6	62.0	60.2	55.9	56.8	51.2	48.0	53.1
DIESEL TRACTORS												
John Deere	"70"	45	72.2	64.0	63.1	64.5	60.0	56.3	51.3	52.4	50.3	45.8
Oliver	"Super 88"	47	67.8	68.6	67.9	62.7	57.1	51.9	49.4	44.8	36.3	37.6
PULL TYPE COMBINES		(TYPE)										
John Deere	"65"	PTO-12'	59.8	61.4	58.3	54.9	49.3	38.1	32.8	27.5	23.9	22.3
International Harvester	"76"	PTO-7'	65.0	72.9	57.7	46.3	51.1	36.5	34.8	30.7	28.0	21.9
SELF PROPELLED												
Gleaner Baldwin	"A"	14'	--	55.8	55.0	54.5	49.7	39.5	36.7	37.8	35.8	31.7
Massey Harris	"90"	12'	72.7	53.5	51.1	56.9	53.6	43.9	40.5	36.0	32.8	28.8
BALERS												
John Deere	"114-W"	PTO-W	57.6	50.1	40.8	33.9	30.5	23.0	18.8	16.2	14.4	8.9
International Harvester	"45-T"	PTO-T	58.5	52.8	53.4	43.3	38.7	30.0	28.0	24.8	22.0	17.7
New Holland	"Super 77"	PTO-T	53.2	46.0	47.8	40.8	35.6	32.0	27.2	24.3	21.7	--

APPENDIX TABLE C-I (cont'd)

MAKE	MODEL	OTHER	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
Oliver	"50"	PTO-T	60.3	52.9	49.0	45.6	40.3	35.7	34.0	29.3	26.0	27.3
FORAGE HARVESTERS												
Papec	"92"	Cb	--	60.7	60.5	55.7	42.7	41.6	36.3	32.7	28.3	25.0
Gehl	--	Rc	55.4	--	60.1	55.4	40.3	37.5	34.2	30.2	28.7	25.1
Fox	"F-544"	Pu	--	--	55.9	54.6	43.6	36.1	31.2	27.7	23.3	21.9
International Harvester	"20-C"	Rc	56.4	46.4	52.0	47.6	40.0	35.0	29.7	26.5	23.6	21.1
CORN PICKERS												
Case	"PR"	PT-1	54.9	49.1	49.5	49.3	50.4	37.6	33.8	27.9	24.1	--
Ford	"16-66"	Mtd-2	57.1	59.8	57.8	62.8	66.5	45.2	42.0	33.9	34.5	--
Minneapolis Moline	"Husker"	Pt-2	56.8	54.9	53.5	55.9	48.3	41.5	41.5	34.5	30.5	--

Where: PTO indicates power takeoff and for:

Combines--7----14' refers to header width

Balers--T is for twine tie and W is for wire tie

Forage Harvesters--Cb indicates cutterbar attachment, Rc is for rowcrop attachment, Pu is for pickup attachment

Corn Pickers--Pt indicates pull type, Mtd indicates mounted, and 1 or 2 indicates the number of rows harvested.

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