

**EFFECTS OF TAXES AND AGE ON DEPRECIATION:
THE CASE OF COMBINE HARVESTERS**

by

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APPROVAL

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ABSTRACT

Economic depreciation of the total capital stock of a physical asset is determined by the flow of services used in productive activities and by the size of the capital stock. Previous research studies have attempted to analyze economic depreciation by modeling the flow of services. These studies have often failed to fully specify the model by not including important asset specific explanatory variables, and their models were often estimated with restricted functional forms, which implicitly limited the pattern of economic depreciation.

This study, on the other hand, uses a flexible functional form which models price as an exponential quadratic function of age, and thus allows the pattern of economic depreciation to be derived within the model. The behavior of used asset prices are also estimated as an explicit dynamic process which permits a stronger statistical test of the results. In examining the economic depreciation of combine harvesters, this study utilizes specific explanatory variables to account for the effects of changes in the tax code, shocks in demand, and quality and technology differences across combine harvester models.

The major empirical results of this study state that depreciation rates are not constant across different ages of combine harvesters and that depreciation rates and patterns are not stable with respect to changes in tax codes. These results present evidence that if further examination of either economic depreciation or optimal replacement problems are to be solved in an internally consistent manner, a more flexible functional form of the used asset price equation must be utilized such as the flexible functional form used in this study, and changes in the tax code must be included as a specific explanatory variable.

CHAPTER 1

INTRODUCTION

Economic depreciation is an important factor in measuring net capital accumulation in the aggregate and in determining investment and replacement decisions for a physical asset at the firm level. Economic and technological variables that affect the value of capital services will also affect the economic rate of depreciation, assuming that the rate of depreciation of a physical asset is determined by the flow of capital services into productive activities. Accurately measuring economic depreciation has important implications with respect to current agricultural issues such as the capital/labor ratio, farm size, and efficient firm management investment decisions.

These implications are important in that government tax policies have been legislated and firm management decisions have been made using remaining value functions that have often assumed a constant rate of depreciation. The constant rate of depreciation hypothesis has been used in several previous studies. This study, however, questions the validity of the constant rate hypothesis. In addition, previous studies have failed to consider several important factors that affect the value of capital services and therefore asset price. One such

factor is the potential effect of tax policy changes upon asset values and costs.

The objective of this analysis is to statistically test two hypotheses. The first hypothesis is that economic depreciation occurs at a constant rate or (more simply) that the rate of depreciation does not change with the age of an asset. The second hypothesis is that the pattern and rate of depreciation are not affected by different tax regimes (major changes in the tax policy). This study examines the depreciation schedule for a major farm production asset, combine harvesters. An estimation model for used asset price is developed using a flexible functional form and is estimated as a dynamic process. The model includes asset specific explanatory variables to account for the effects of changes in the tax laws, shocks in demand, and quality and technology differences across combine harvester models.

This study is innovative in that it is the first study to use a flexible functional form that estimates the behavior of used asset prices as an explicitly dynamic process. This procedure permits a more powerful statistical test of the constant depreciation hypothesis because the effects of age can be examined at the margin and permits the data to reflect various depreciation patterns that might exist. The study also examines the effect of tax and demand shift variables on asset prices.

The thesis is organized as follows. In Chapter 2, a review of previous studies of used asset prices is presented, and the findings of these studies are discussed. In Chapter 3, a general theoretical model of the determinants of prices is presented and an expression for the rate of depreciation is derived. Changes in the tax code are shown to have potentially complex effects upon the rate and pattern of depreciation. In addition, four explicit models of asset prices are presented. The data used for the econometric estimation of parameters of explicit used asset price models for combine harvesters are described in Chapter 4. In Chapter 5, the estimated parameters of the combine harvester models are presented, and the implications of the results are examined. The summary and conclusions of the combine harvester case study are presented in Chapter 6.

CHAPTER 2

REVIEW OF LITERATURE

Understanding of depreciation is important at both the macro and micro level. Depreciation of the total capital stock of a physical asset is determined by the size of the capital stock and the flow of services used in productive activities. Understanding depreciation is also important in decisions about asset replacement at the firm level (Reid and Bradford, 1983, 1987). For analytical convenience, the rate of depreciation is often assumed to be constant over the asset's life. This assumption has been justified by an appeal to renewal theory (Jorgenson, 1976). Several empirical studies of asset prices have supported the constant depreciation rate hypothesis (Hulten and Wykoff, 1981; Hall, 1973), although Lee (1978) provided evidence that the hypothesis does not hold in the case of Japanese fishing vessels. Recently, examining tractor auction data, Perry and Glyer (1990) have concluded that while individual tractors may not depreciate at a constant rate, the aggregate depreciation rate for all tractors is "near constant."

In contrast, Feldstein and Rothschild (1974) provided a theoretical critique of the plausibility of assuming constant rate of depreciation for the aggregate capital stock. In

addition, Feldstein and Foot (1971) and Eisner (1972) showed that in U.S. manufacturing industries the ratio of replacement investment to gross investment varied in a manner completely inconsistent with a constant depreciation rate. Econometric analyses of physical depreciation also suggest that the depreciation rate is not constant at the sector level (Bitros, 1976; Bitros and Kelejian, 1974; Cowing and Smith, 1977). Penson et al. (1977), using engineering data, argued that for individual tractors the rate of depreciation increases.

Four of the above studies are particularly relevant to this analysis: Hall (1973), Reid and Bradford (1983, 1987), Hulten and Wykoff (1981), and Perry and Glyer (1990). These studies utilized one or both of two concepts examined by this present study. These concepts are: (1) the use of a flexible functional form which allows empirical estimation of depreciation rates and patterns (Hall, Reid and Bradford, Hulten and Wykoff, Perry and Glyer), and (2) the incorporation of tax variables (Reid and Bradford).

Reid and Bradford (1983, 1987), in large part following Hall (1973), developed a model to solve situation specific optimal replacement problems. In their model, they developed a used asset price equation which included age, net farm income, dummy variables for tractor models, and dummy variables for technology differences. Reid and Bradford's optimal replacement model accounted for the effects of

different tax policies when computing the optimal replacement solution.

Hulten and Wykoff (1981) applied the Box-Cox power transformation to the problem of estimating the rate and the form of the economic depreciation pattern for commercial and industrial structures. The Box-Cox transformation is a flexible functional form capable of discriminating among geometric, linear, and "one-hoss-shay" depreciation patterns. The Box-Cox power transformation has the following form:

$$\hat{P}_i = \alpha + \beta \hat{s}_i + \gamma \hat{t}_i + u_i \quad i=1, \dots, N \quad (2.1)$$

where

$$\hat{P}_i = \frac{(P_i^{\theta_1} - 1)}{\theta_1}, \quad \hat{s}_i = \frac{(s_i^{\theta_2} - 1)}{\theta_2}, \quad \hat{t}_i = \frac{(t_i^{\theta_3} - 1)}{\theta_3} \quad (2.2)$$

In equation (2.1), P_i represents the market price of an asset of age s in year t for observation i . Hulten and Wykoff concluded that for commercial and industrial structures asset price depreciation followed either an accelerated, straight-line, or (possibly) geometric pattern. However, it was definitely not a decelerated, linear, or "one-hoss-shay" pattern. In a cross-section analysis, Hulten and Wykoff estimated their model using different years of their data set and compared the resulting parameters. They concluded that depreciation rates were reasonably stable over time, suggesting that the rate of depreciation is constant.

Perry and Glyer (1990) attempted to explain why both non-constant rates of depreciation and constant rate geometric depreciation patterns for tractors could be empirically consistent. They hypothesized that while the aggregate depreciation rate for all tractors may well be "near constant," an individual tractor may have a non-constant depreciation rate.

Perry and Glyer (1990) first examined an aggregate simulation model which was used to calculate used asset prices in a controlled decision making environment. The simulation model is:

$$RV = \sum_{t=t_1}^T [(\bar{P}_t \cdot C_t - \bar{R}_t - \bar{B}_t) (1-\alpha) + \alpha \bar{D}_t] e^{r(t_1-t)} \quad (2.3)$$

where P is the value of output, C is the productivity capacity, R is the repair and maintenance cost, B is the reliability costs, α is the marginal tax rate, r is the discount rate, and D is the amount of tax depreciation allowance claimed in time t . $\bar{P}$, $\bar{R}$, $\bar{B}$, and $\bar{D}$ are all proportions of the purchase price. Using this model, Perry and Glyer concluded that the aggregate depreciation rate from such a model was constant. They then proceeded to estimate a Box-Cox power transformation used asset price equation function. Assuming that the depreciation rate is influenced by the age, usage, and care of a particular machine, Perry and Glyer transformed the three variables and derived power transformation parameters for each using auction data for

individual tractors. Aggregate depreciation rates for all tractors were also calculated by using weighted averages. Perry and Glyer concluded that even if an individual asset had an accelerated depreciation pattern, it would not be inconsistent to expect a geometric pattern in the aggregate. By visual inspection, they also concluded that the econometric results they obtained were not greatly different from their simulation results which they claimed could be used for assets that are not commonly traded.

The analysis presented here takes into consideration the effects of taxes by including a tax variable in the used asset price equation together with other situation specific variables. The used asset price equation utilized in this analysis is not the flexible Box-Cox power transformation functional form, but an alternative polynomial flexible functional form which allows for many different depreciation patterns. This flexible form is also attractive in that its parameters can be estimated using more powerful statistical methods than those used in most previous studies.

CHAPTER 3

MODEL DEVELOPMENT

Theoretical Model

The equilibrium price of an asset is assumed to equal the present value of the net revenue stream it generates (Faustmann, 1849; Fisher, 1907, 1930; Taylor, 1923; Hotelling, 1925). Ignoring tax recapture and scrap value, let $P(s)$ denote the asset price at age s , D the present value of the depreciation allowances permitted per dollar of the price of the asset, T the marginal tax rate, i the percent of the asset price allowed as an investment tax credit, $R(a)$ the net returns for the asset at age a , and ρ the after-tax discount rate. Therefore, the price of an asset of age s can be written as:

$$P(s) = (1-T) \int_s^{\infty} R(a) e^{-\rho(a-s)} da + i \cdot P(s) + T \cdot D \cdot P(s) \quad (3.1)$$

In equation 3.1, all investment tax credits ($i \cdot P(s)$) are used immediately, thus avoiding complications due to investment tax credit carryover. Investment tax credits directly reduce income tax and are added directly back into net returns. $T \cdot D \cdot P(s)$ is the net present value of tax reductions induced by tax depreciation allowances.

Two important implications of the above model are as follows. First, any event that increases (decreases) net revenues will increase (decrease) the asset's price. Second, taxes have a complex and indirect effect on the net revenue stream.

The second implication can be illustrated by solving equation (3.1) for $P(s)$; that is,

$$P(s) = \frac{(1-T)}{(1-TD-i)} \cdot \int_s^{\infty} R(a) e^{-\rho(a-s)} da \quad (3.2)$$

Taking the derivative of the above equation with respect to age, the following result is obtained:

$$\frac{\partial P(s)}{\partial s} = \frac{(1-T)}{(1-TD-i)} \cdot \int_s^{\infty} \frac{\partial R(a)}{\partial a} e^{-\rho(a-s)} da \quad (3.3)$$

Dividing equation (3.3) by $P(s)$, substituting appropriately for $P(s)$ using equation (3.2) and rearranging terms, the rate of economic depreciation can be expressed as:

$$\frac{[\partial P(s) / \partial s]}{P(s)} = \frac{\int_s^{\infty} (\partial R(a) / \partial a) e^{-\rho(a-s)} da}{\int_s^{\infty} R(a) e^{-\rho(a-s)} da} \quad (3.4)$$

Equation (3.4) appears to suggest that the rate of economic depreciation is independent of the tax structure. However, in this case, appearances are deceptive because the components of the net revenue stream (the $R(a)$'s and the after-tax discount rate, ρ) themselves are in part determined by the tax structure.

The after-tax discount rate, ρ , will be affected by changes in the marginal tax rate, T , although the precise

effects depend on general equilibrium considerations (for a discussion of this issue see Alston, 1986, or Darby, 1975). The effects of changes in the tax code on the $R(a)$'s are more subtle.

Suppose, to facilitate the discussion, that the price of a new asset, $P(0)$, is constant with respect to changes in tax policy. (This assumption would hold if the industry purchases a small share of the total supply of the asset or, alternatively, the asset is produced with a constant returns to scale technology using inputs that are in elastic supply and intra-firm adjustment costs are not related to the level of investment in new equipment.) If the asset is new (that is, $s=0$) then equation (3.2) can be rewritten as:

$$P(0) = \frac{(1-T)}{(1-TD-i)} \cdot \int_0^{\infty} R(a) e^{-p(a)} da \quad (3.5)$$

or, rearranging terms,

$$\int_0^{\infty} R(a) e^{-pa} = \frac{(1-TD-i)}{(1-T)} \cdot P(0) \quad (3.6)$$

If $P(0)$ is constant, then the net revenue stream depends on the tax structure. For example, an increase in either D or i will reduce the present value of the net revenue stream for the new asset. Qualitatively similar results are obtained if $P(0)$ changes in response to changes in the level of gross investment as long as the elasticity of supply of the asset is positive. T has no predictable effect on the revenue stream

if D and i are assumed to be less than one and greater than zero.

These results can be explained in terms of what happens to the user cost of a unit of service from capital equipment. If D or i increase, the user cost or rental price of services from the asset falls. The result is substitution of the asset for other inputs (typically labor) and expansion of the industry in which the asset is used because production costs have declined. The former effect reduces the marginal physical product of the asset; the latter reduces the price of the industry's output. Both effects lower the value of the marginal product for the services of the asset, and net revenues from the services fall. The decline in the marginal value product of asset services also reduces net revenues associated with older machines and thus affects the pattern of economic depreciation.

The changes in depreciation rates across ages may be very complex if intricate changes in net revenue levels (the $R(a)$'s) occur as a result of changes in tax policy. This study, therefore, seeks to examine two testable hypotheses. The first hypothesis is that depreciation rates of combine harvesters are constant over the life of the combine. The second hypothesis is that changes in tax policy do not affect rates or the patterns of depreciation. Testing the hypothesis is tantamount to testing whether the integral expression in

equations (3.2) and (3.3) is unaffected by changes in tax policy.

Flexible Functional Forms for Asset Price Models

Estimating equations (3.2) and (3.3) directly will be extremely difficult due to the complexity of the integral expressions, and data problems with respect to quasi-rents and after the tax discount rate. However, equation (3.2) can be approximated with various flexible functional forms replacing the right-hand side of (3.2).

Previous Functional Forms

Flexible functional forms have been utilized in empirical used asset price models, but the extent of their flexibility has been somewhat limited. Some of the studies that have used a flexible functional form are Hall (1973), Lee (1978), Hulten and Wykoff (1981), and Perry and Glyer (1990). One of the more commonly used flexible functions has been the Box-Cox power transformation.

The Box-Cox power transformation allows the joint estimation of parameters that determine specific functional forms and also parameters which determine the slope and intercept of the equation. The Box-Cox power transformation function specified by Hulten and Wykoff (1981) is:

$$\hat{P}(s)_i = \alpha + \beta \hat{s}_i + \gamma \hat{t}_i + u_i \quad i=1, \dots, N \quad (3.7)$$

where

$$\hat{P}(s)_i = \frac{(P(s)_i^{\theta_1}-1)}{\theta_1}, \quad \hat{s}_i = \frac{(s_i^{\theta_2}-1)}{\theta_2}, \quad \hat{t}_i = \frac{(t_i^{\theta_3}-1)}{\theta_3} \quad (3.8)$$

and α, β, γ , and $\theta=(\theta_1, \theta_2, \theta_3)$ are constant parameters. $P(s)_i$ represents the market price of an asset of age s_i in year t_i for observation i .

In equation (3.7), the unknown parameters (α, β, γ) determine the intercept and slope(s) of the model, while in equation (3.8) the unknown vector $\theta=(\theta_1, \theta_2, \theta_3)$ determines the functional form. Thus, as the elements of θ take on different values, the functional form of equation (3.7) changes. As a result, the model may reflect a linear, decelerated, or geometrically constant depreciation pattern.

A linear form exists if $\theta=(1,1,1)$. The Box-Cox function then becomes:

$$P(s)_i = (\alpha - \beta - \gamma + 1) + \beta s_i + \gamma t_i + u_i \quad i=1, \dots, N \quad (3.9)$$

This model has frequent accounting and tax applications. A geometric decay model can also be derived by restricting $\theta=(0,1,1)$. In this case a semi-log function results:

$$\ln P(s)_i = (\alpha - \beta - \gamma) + \beta s_i + \gamma t_i + u_i \quad i=1, \dots, N \quad (3.10)$$

This form of economic depreciation has been justified by appeals to renewal theory (for example, Jorgenson, 1976).

Another commonly assumed depreciation pattern is a one-hoss shay pattern in which the price of an asset declines

gradually in the early years of asset life and accelerates rapidly as the date of retirement approaches. A similar model can be derived by the Box-Cox function by restricting $\theta=(1,3,1)$; that is,

$$P(s)_i = (\alpha - \frac{1}{3}\beta - \gamma + 1) + \frac{1}{3}\beta (s_i)^3 + \gamma t_i + u_i \quad i = 1, \dots, N \quad (3.11)$$

In this case, the function becomes cubic in age which causes depreciation to be slow during the early years while being rapid at the end of the asset's life.

The Box-Cox power transformation is a flexible form that represents a dynamic process. However, the Box-Cox function was estimated only in price levels and was not estimated as a dynamic process.

Alternative Functional Forms

In this study, a different functional form is considered which also models asset price behavior as a dynamic process. The first model, Model 1, is the following declining balance function, which is functionally equivalent to the remaining value function in the Agricultural Engineers Yearbook:

$$P(s) = \alpha \beta^s \quad (3.12)$$

where α and β are constants. In order to represent the behavior of the asset price as a dynamic process, equation 3.12 is lagged one period $P(s-1)$, $P(s)$ is subtracted by $P(s-1)$, the terms are rearranged, and the following model is derived:

$$P(s) = \beta P(s-1) \quad (3.13)$$

This function has little flexibility in its structure, because it implicitly assumes that the asset loses a constant fraction of its value $(1-\beta)$ each time period. The instantaneous rate of depreciation for Model 1 is constant; that is,

$$\frac{d(\ln P(s))/ds}{P(s)} = \ln \beta \quad (3.14)$$

Model 2 differs from Model 1 only in that an intercept term (δ) is added. This allows for increased flexibility in that it no longer imposes the restriction that the rate of depreciation be constant. Model 2 is:

$$P(s) = \delta + \alpha \beta^s \quad (3.15)$$

Model 2 contains a constant exponential component in the equation; however, the depreciation base is no longer $P(s)$, but $P(s)-\delta$. Solving for $P(s)$ in terms of $P(s-1)$, it follows that:

$$P(s) = \theta + \beta \cdot P(s-1) \quad (3.16)$$

where $\theta = \delta(1-\beta)$. The instantaneous rate of economic depreciation implied by Model 2 is:

$$\frac{dP(s)/ds}{P(s)} = \frac{\alpha \beta^s \ln \beta}{\delta + \alpha \beta^s} \quad (3.17)$$

Thus if $\delta \neq 0$, then the rate at which the asset price depreciates is not constant. However, if $\delta = 0$, then the rate

of depreciation is constant. Thus it can be noted that Model 1 is nested within Model 2.

Model 3 contains additional properties. In Model 3, price is assumed to be an exponential quadratic function of age; that is,

$$P(s) = \alpha e^{\beta s + \gamma s^2} \quad (3.18)$$

where α , β , and γ are constants. The change in asset price over time for equation (3.18) can be found in the same manner as the first two models. After subtracting $P(s)-P(s-1)$ and rearranging terms, the following expression is derived:

$$P(s) = P(s-1) \cdot e^{\phi + \theta s} \quad (3.19)$$

where $\phi = \beta + \gamma$; $\theta = 2\gamma$. Note that :

$$\frac{dP(s)/ds}{P(s)} = (\beta + 2\gamma s) \quad (3.20)$$

Model 3 is a relatively inflexible functional form in that the rate of depreciation is a linear function of age.

Model 4 differs from Model 3 only in that it includes a constant term, δ ; that is,

$$P(s) = \delta + \alpha e^{\beta s + \gamma s^2} \quad (3.21)$$

where α , β , δ , and γ are constants. Through recursive substitution, the following equation is derived:

$$P(s) = [P(s-1) - \delta] [e^{\phi + \theta s}] + \delta \quad (3.22)$$

where $\phi = \beta + \gamma$; $\theta = 2\gamma$. This model has the most flexible function form. The rate of depreciation is:

$$\frac{dP(s)/ds}{P(s)} = \frac{\alpha(\beta + 2\gamma s)e^{(\beta s + \gamma s^2)}}{\delta + \alpha e^{(\beta s + \gamma s^2)}} \quad (3.23)$$

For example, if $\delta = 0$, then a test for Model 3 is available, because the rate of depreciation is variable but in a linear fashion. If γ is positive, the rate of depreciation increases in a linear fashion; if γ is negative, the inverse is true. If $\theta = 0$ (which implies $\gamma = 0$) and $\delta = 0$, then Model 4 represents a declining balance function in which the rate of depreciation is constant (β). The model becomes:

$$P(s) = P(s-1) \cdot e^{\beta} \quad (3.24)$$

where β is negative. If $\theta = 0$ and $\delta \neq 0$, then the constant exponential component of the equation is adjusted by δ which means the depreciation rate is no longer constant. An equation similar to Model 2 (equation 3.16) is thus derived:

$$P(s) = \delta(1 - e^{\beta}) + e^{\beta} \cdot P(s-1) \quad (3.25)$$

If both θ and δ are non-zero, Model 4 holds. Thus a direct test to reject the hypothesis, that the rate of depreciation is constant over time, is available. In other words, if either θ or δ is a non-zero value, age directly affects the rate of depreciation.

In this chapter, alternative models of asset price behavior have been presented. The models were based on a

dynamic specification of the behavior of the asset's price over its life, while still having somewhat flexible functional forms. These estimation models, however, are not asset specific. The development of a specific estimation equation for combine harvesters requires an understanding of what factors influence the prices for these assets, and the nature of data sets available for estimating the used asset price function.

The data sets selected to estimate models of asset prices for combine harvesters are presented in Chapter 4. Specific asset estimation equations and econometric estimates are presented in Chapter 5.

CHAPTER 4

DATA

The purpose of this study is to estimate used asset price functions for combine harvesters in order to test the hypothesis that the rate of economic depreciation is constant. In addition, the hypothesis that changes in tax policy affect economic depreciation rates is examined. Data were gathered on prices and other characteristics of 23 combine harvesters for the time period 1979-1989. The combines included in the sample were chosen because they are relatively homogeneous with respect to harvesting capacities and model technologies. Data were obtained from the 1979-1989 issues of the National Farm and Power Equipment Dealers Association (NFPEDA) publication, Official Guide for Tractors and Farm Equipment, and consisted of first year manufacturers' list prices and resale prices. The 1987-1989 issues of Quick Reference Guide for Farm Tractors and Combines, which is published by Hot Line, Inc., was also used as a source of data to facilitate the selection of combines to be used in the study because of the detailed information it contained on tested horsepower and field capacities.

The 23 combine models included in the sample were manufactured by six different firms. The manufacturers were

Allis-Chalmers, John Deere, International Harvester-McCormick, Massey-Ferguson, New Holland, and White. A list of each of the combine harvester models included in the data set, together with their characteristics, is presented in Table (1).

The data set contains 2,323 different observations of which 2,144 are relevant to prices for used machines. The prices reported by NFPEDA in the Official Guide for Tractors and Farm Equipment are based on the average of actual farm dealers' selling prices after adjusting for reconditioning costs. This data set is listed in Appendix A.

Price information included in this data set was obtained in the following manner. In any given year, spring and fall prices were available for each age of a given combine model. Thus, for example, in the fall of 1982, prices were collected for new, one year old, two year old, and three year old John Deere model 7720 combines (the model having been introduced in 1979).

Two concerns about the data set are: (1) average prices for traded combine harvesters may reflect the sale of a disproportionate number of "lemons," especially in the case of newer machines (Akerlof, 1970); and (2) new machinery prices are manufacturers' list prices instead of market negotiated selling prices (Perry and Glyer, 1990). Reported average used combine prices will be biased downward as a measure of the average value of all assets if a disproportionate number of "lemons" are being disposed of in the market. The lemons

Table 1. Combine model information.

Manufacturer	Model	Horse Power	Bushel Cap.	Weight	Years	Type*
ALLIS- CHALMERS	L2	145	200	16177	1976-82	C
	L3	145	200	16177	1983-85	C
	M2	130	180	15207	1976-80	C
	M3	130	180	15552	1983-85	C
	N5	190	200	21405	1979-85	C
JOHN DEERE	6620	125	166	18048	1979-88	C
	7700	128	129	16256	1970-78	C
	7720	145	190	19834	1979-88	C
INTERNATIONAL HARVESTER- McCORMICK	815	125	133	15587	1969-79	C
	915	130	146	17373	1969-79	C
	1440	135	145	18818	1978-85	A
	1460	170	180	19558	1978-85	A
MASSY- FERGUSON	550	125	125	14908	1978-88	C
	750	140	140	23136	1973-80	C
	760	145	180	21516	1972-80	C
	850	150	140	23231	1982-88	C
NEW HOLLAND	1500	125	133	15402	1973-80	C
	TR-70	160	145	17241	1975-80	A
	TR-75	155	140	21718	1979-85	A
	TR-85	175	190	21944	1979-85	A
WHITE	8600	130	150	14896	1974-77	C
	8800	145	170	16571	1974-77	C
	8900	145	170	19761	1978-81	C

* Thresher type-Cylinder (C) or Axial Rotor (A).

problem is intractable. However, it seems likely that asset values of non-traded combines move in the same direction as asset prices for traded combines. A separate and more tractable problem is that the manufacturers' list prices overstate actual market prices for new machines. Therefore, care should be taken to account for the list price problem in econometric models of asset price behavior. This issue is discussed in more detail later in this analysis.

In order to account for demand shocks that affect the structure and level of asset prices, annual data on gross farm income for field crops were gathered for the period 1979-1989. The data were obtained from various issues of the USDA publication, Economic Indicators of the Farm Sector: National Financial Summary, for the period 1979-1988. Information on gross farm income for field crops for 1989 was not available. Instead the most recent USDA estimate for gross farm income of field crops was obtained from the USDA September, 1989 issue of Agricultural Outlook. The nominal combine harvester price and gross farm income data were converted into real terms by the Gross National Product implicit price deflator.

One of the objectives of this analysis was to examine what effect different tax policies have on used asset prices. For this study, the specific estimation equation includes variables that account for different tax regimes; that is, periods which differ significantly with respect to the structure of the tax code.

The federal tax code contains several provisions that affect investment and capital use decisions: the tax rate schedules, tax depreciation schedules, the allowance of investment tax credit (ITC), ITC recapture, ITC carryover, and expensing. A major change in any of the above as part of the tax code may affect the pattern of used asset prices, and thus alter the tax regime under which such decisions are made.

In 1979, the tax policy consisted of a 10% ITC of the eligible base up to \$25,000 and 7% of the base over \$25,000, ITC recapture, either a straight-line or double-declining depreciation schedule with an additional first year depreciation, and an eight year tax life for combines. The tax code was relatively stable until 1981. In 1981, the Economic Recovery Tax Act (ERTA) was enacted. The ERTA expanded the ITC to 10% of the eligible base up to \$25,000 and 9% of the base over \$25,000. The ERTA also introduced accelerated depreciation schedules under which, for example, a combine harvester would have the following percentages of asset price as a depreciation: 15%, 22%, 21%, 21%, 21%. In addition, under ERTA the additional first year depreciation provision was replaced with an expensing option, which in turn reduced the ITC basis. Finally, the ERTA also reduced marginal tax rates, and shortened the depreciation tax life for combines to five years from eight years.

Further significant tax revisions were enacted in 1984 with the modification of depreciation schedules and consequent

reductions in their net present values. This took the form of the Modified Accelerated Cost Recovery System (MACRS) which combined the double-declining balance schedule with the half year convention method. A third set of major tax code revisions took place in 1986 under the provisions of the Tax Reform Act (TRA). The TRA abolished the ITC and ITC carryovers, extended the depreciation tax life for combines from five to seven years, and lowered marginal tax rates for agricultural producers. Since the enactment of the TRA, tax policies have remained relatively stable.

Thus, data in this sample were generated under four distinct tax regimes. These tax regimes consist of the following periods: 1979-81, 1982-84, 1985-86, and 1987-89. The assumption is made that the changes in the tax codes affected asset prices the year after Congress passed the tax legislation, as the legislation was usually enacted late in the calendar year. The four tax regimes are accounted for in the econometric analysis through the use of three tax dummy variables.

Economic depreciation rates may differ across combine models or manufacturers because of slight differences in the technologies embodied in each model or manufacturer product. If each individual combine model is assumed to have a slightly different depreciation pattern, the effects of these differences may (in part) be explained by 22 model dummy variables. However, if it is assumed that there is no

significant difference in the depreciation patterns for the models of a particular manufacturer, but that there exist slight differences between manufacturers, then only five manufacturer dummy variables are required.

The following variables thus are incorporated into the estimation models presented in Chapter 5. Real gross farm income from field crops (GFI) is included in the model to account for demand shocks that affect the structure and level of asset prices. The corresponding coefficient is expected to be positive. Three slope and intercept tax dummies (T) are included to account for the effects of tax changes on asset prices. The problem of manufacturer's list price is accounted for by a new price dummy variable (D1). D1 is expected to have a negative coefficient. Either combine model or manufacturer dummy variables (M_i 's) are used to account for the slight technology differences that might exist between individual models or across manufacturers. Model and manufacturer dummies cannot be included in the same equation because of singularity between the sets of dummies. Thus the symbol M is used interchangeably in the following discussion. Finally, a dummy variable (SF) is included to test for systematic differences in combine prices between spring and fall. SF is expected to have a negative coefficient which is equal to the interest cost of holding a combine six months, from December to June.

CHAPTER 5

ESTIMATION MODEL DEVELOPMENT

AND EMPIRICAL RESULTS

Specific estimation models are developed in this chapter for the four asset price models presented in Chapter 3 using the explanatory variables that were discussed in Chapter 4. The order and procedure by which these models are analyzed is examined, and the results of the econometric estimates are presented in detail. Finally, major implications of these results are discussed.

Estimation Model Development

Specific estimation models are developed for the following four asset price models:

Model 1

$$P(s) = \beta P(s-1) \quad (5.1)$$

Model 2

$$P(s) = \theta + \beta \cdot P(s-1) \quad (5.2)$$

Model 3

$$P(s) = P(s-1) \cdot e^{(\phi + \theta s)} \quad (5.3)$$

Model 4

$$P(s) = [P(s-1) - \delta] [e^{\phi + \theta s}] + \delta \quad (5.4)$$

The following variable notation is used in specifying the estimation equations. $P(s)_{i,t}$ denotes the asset price for model i at time period t , $D1$ the new machine list price dummy variable, SF the spring/fall dummy variable, GFI_t real gross farm income for time period t , M_k the k 'th model or manufacturer dummy variable, T_j the j 'th tax regime dummy variable, and s the age of the machine. $D1$ equals one for new machine list prices and zero for used combine resale prices; SF equals zero for spring prices and one for fall prices.

The most general estimation equation associated with Model 1 assumes that β (the parameter associated with $P(s-1)$) is a linear function of $D1$, SF , GFI , model/manufacturer and tax dummy variables. The general estimation model is:

$$P(s)_{i,t} = \left[\beta_o + \beta_{D1} D1 + \beta_{SF} SF + \beta_{GFI} GFI_t + \sum_{k=1}^{K=m} \beta_k M_k + \sum_{j=1}^{J=3} \beta_j T_j \right] \cdot P(s-1)_{i,t} + \epsilon_{i,t} \quad (5.5)$$

where $\epsilon_{i,t}$ is an additive error term. Note that the above model has no intercept term, and thus it corresponds exactly to Model 1.

Model 2 is similar to Model 1 except that it includes an intercept term. The most general estimation equation corresponding to Model 2 assumes that both θ and β are functions of the exogenous variables. The general estimation model associated with Model 2 can therefore be specified as:

$$\begin{aligned}
 P(s)_{i,t} = & \left[\theta_o + \sum_{k=1}^{k=m} \theta_k M_k + \sum_{j=1}^{j=3} \theta_j T_j \right] + \left[\beta_o + \beta_{DI} DI + \beta_{SF} SF \right. \\
 & \left. + \beta_{GFI} GFI + \sum_{k=1}^{k=m} \beta_k M_k + \sum_{j=1}^{j=3} \beta_j T_j \right] \cdot P(s-1)_{i,t} + e_{i,t}
 \end{aligned} \tag{5.6}$$

where $e_{i,t}$ is an additive error term.

Equations (5.5) and (5.6) are linear in their parameters and are assumed to have additive error structures. These two models therefore can be estimated using the Ordinary Least Squares (OLS) procedure in SHAZAM, Version 6.1 (White et al., 1988).

In Model 3, the rate of depreciation is an exponential function of age. The estimation equation associated with Model 3 assumes that the parameters of the exponential function, ϕ and θ , are themselves functions of the exogenous variables. Thus,

$$\begin{aligned}
 P(s)_{i,t} = & P(s-1)_{i,t} \cdot \left[\exp(\phi_o + \phi_{DI} DI + \phi_{SF} SF + \sum_{k=1}^{k=m} \phi_k M_k \right. \\
 & \left. + \sum_{j=1}^{j=3} \phi_j T_j + \phi_{GFI} GFI + \theta_o S + \sum_{k=1}^{k=m} \theta_k M_k \cdot S + \sum_{j=1}^{j=3} \theta_j T_j \cdot S) \right] + e_{i,t}
 \end{aligned} \tag{5.7}$$

Equation (5.7) assumes that the error structure is additive. Consequently, because the estimation equation is non-linear in its parameters, it must be estimated using a non-linear estimation procedure.

If Model 3 is assumed to have a multiplicative error structure ($v_{i,t}$), the estimation equation can be written as:

$$\begin{aligned}
 P(s)_{i,t} = & P(s-1)_{i,t} \cdot \left[\exp(\phi_o + \phi_{DI} DI + \phi_{SF} SF + \sum_{k=1}^{k=m} \phi_k M_k \right. \\
 & \left. + \sum_{j=1}^{j=3} \phi_j T_j + \phi_{GFI} GFI + \theta_o S + \sum_{k=1}^{k=m} \theta_k M_k \cdot S + \sum_{j=1}^{j=3} \theta_j T_j \cdot S) \right] \cdot v_{i,t}
 \end{aligned} \tag{5.8}$$

Taking logs of both sides of equation (5.8), the following expression is obtain:

$$\ln P(s)_{i,t} = \ln P(s-1)_{i,t} + \left[\phi_o + \phi_{DI}DI + \phi_{SF}SF + \sum_{k=1}^{k=m} \phi_k M_k + \sum_{j=1}^{j=3} \phi_j T_j + \phi_{GFI}GFI \right] + \left[\theta_o \cdot S + \sum_{k=1}^{k=m} \theta_k M_k \cdot S + \sum_{j=1}^{j=3} \theta_j T_j \cdot S \right] + \epsilon_{i,t} \quad (5.9)$$

where $\epsilon_{i,t} = \ln v_{i,t}$. Equation (5.9) is also linear in its parameters and can be estimated using OLS.

Model 4 differs from Model 3 in that Model 4 contains a constant, δ . The estimation equations associated with Model 4 assume δ is not a function of the exogenous variables while assuming ϕ and θ are functions of the exogenous variable. Under these assumptions and with the additional assumption that the error structure ($\epsilon_{i,t}$) is additive, the estimation equation of Model 4 is:

$$P(s)_{i,t} = \left[[P(s-1)_{i,t} - \delta] \cdot \exp(\phi_o + \phi_{DI}DI + \phi_{SF}SF + \sum_{k=1}^{k=m} \phi_k M_k + \sum_{j=1}^{j=3} \phi_j T_j + \phi_{GFI}GFI + \theta_o S + \sum_{k=1}^{k=m} \theta_k M_k \cdot S + \sum_{j=1}^{j=3} \theta_j T_j \cdot S) \right] + \delta + \epsilon_{i,t} \quad (5.10)$$

If the error structure is assumed to be multiplicative ($v_{i,t}$), the estimation equation associated with Model 4 is:

$$P(s)_{i,t} = \left(\left[[P(s-1)_{i,t} - \delta] \cdot \exp(\phi_o + \phi_{DI}DI + \phi_{SF}SF + \sum_{k=1}^{k=m} \phi_k M_k + \sum_{j=1}^{j=3} \phi_j T_j + \phi_{GFI}GFI + \theta_o S + \sum_{k=1}^{k=m} \theta_k M_k \cdot S + \sum_{j=1}^{j=3} \theta_j T_j \cdot S) \right] + \delta \right) \cdot v_{i,t} \quad (5.11)$$

Taking logs on both sides of equation (5.11) the following expression is obtained:

$$\ln P(s)_{i,t} = \ln \left(\left[[P(s-1)_{i,t} - \delta] \cdot \exp(\phi_o + \phi_{DI}DI + \phi_{SF}SF + \sum_{k=1}^{k=m} \phi_k M_k + \sum_{j=1}^{j=3} \phi_j T_j + \phi_{GFI}GFI + \theta_o S + \sum_{k=1}^{k=m} \theta_k M_k \cdot S + \sum_{j=1}^{j=3} \theta_j T_j \cdot S) \right] + \delta \right) + \epsilon_{i,t} \quad (5.12)$$

where $\epsilon_{i,t} = \ln v_{i,t}$. Model 4 is clearly nonlinear in its parameters, irrespective of whether the error structure is additive or multiplicative, and therefore must be estimated

using a nonlinear estimation procedure such as the nonlinear Quasi-Newton maximum likelihood procedure in SHAZAM which is used in this analysis.

Equation (5.12) has a form that permits a direct test of the two hypotheses. The first hypothesis can be rejected if any of the coefficients on age (S) are statistically significant. The second hypothesis can be rejected if any of the coefficients on either tax intercept or slope dummies (T) are statistically significant. If, however, the coefficients on all T and S are statistically insignificant, both hypotheses cannot be rejected.

Empirical Results

Models 1, 2, and 3 are, in effect, special cases of Model 4 as shown in Chapter 3. Estimation equations based on Model 4 are inherently nonlinear. Thus in order to obtain starting values and reduce the dimensions of the nonlinear estimation problem (because of a convergence problem), several versions of each estimation equation associated with Models 1, 2, and 3 (that is equations 5.5, 5.6, 5.9) are estimated. Each version of any given model differs with respect to tax, model, and manufacturing dummy variables that are included on the slope and intercept terms. The results obtained from estimating Models 1, 2, and 3 are used to screen potential explanatory variables in particular model dummy variables, and thus reduce the complexity of the nonlinear model at a

relatively low cost. Regression equations based on Model 3 are also estimated in order to provide starting values for Model 4. The parameter estimates and statistical results for Models 1, 2, and 3 are listed in Appendix B.

Preliminary Results from Models 1, 2, and 3

The interesting estimation results from Models 1, 2, and 3 are as follows. First, coefficients associated with the five manufacturer dummy variables on either the slopes or the intercept terms appear to provide as much explanatory power as any combination of the 22 model dummy variables on both the slopes and intercepts or equations which included both manufacturer slope and intercept dummies.

Second, the real gross farm income coefficients are positive and significant at the one percent level, while the list price dummy variable coefficients are negative and significant at the one percent level in all of the 62 model versions.

Third, the coefficients attached to the spring/fall dummies are negative and significant at the one percent level in all of the estimation equations associated with Models 1 and 2, while being insignificant at the 10 percent level in all of the estimation equations associated with Model 3.

Fourth, tax dummies appear to affect both intercept and slope terms. For example, in the six variations of equation (5.5), Model 1, all the tax slope dummies are significant at the one percent level. The tax slope dummy coefficients T1

(1982-84) and T3 (1987-89) are positive but negative for T2 (1985-86). In the 28 versions of equation (5.6), Model 2, T2 slope dummy coefficients are also negative and significant at the one percent level. However, the slope coefficients associated with T1 are positive and significant in only six of the fourteen estimated equations which include tax slope dummies, while the coefficients for the other eight are negative in sign and insignificant at the five percent level. It should be noted that six of the T1 slope coefficients are negative and insignificant at the 10 percent level when tax dummies are included on both the slope and intercept terms. Coefficients associated with the T3 slope dummy are significant at the one percent level in 10 of the 14 models, with two more coefficients being significant at the 10 percent level; however, the signs change across equations. T1 and T3 intercept coefficients for Model 2 are positive and significant at the one percent level, while T2 intercept coefficients are positive and significant at the one percent level for 11 of the 14 models, with the other three coefficients being negative and insignificant at the 10 percent level. The 28 variations of equation (5.9), Model 3, have tax slope dummy variable coefficients that are all positive and significant at the one percent level. The results for coefficients of the tax intercept dummies of Model 3 are more mixed. T1 intercept coefficients are positive and significant at the one percent level in five of the 14 models,

while seven of the T1 coefficients are negative and insignificant at the 10 percent level. The remaining two coefficients are positive and significant at the 10 percent level. T2 intercept coefficients are negative and significant at the one percent level in nine of the 14 models, while the other five T2 coefficients are negative; four are insignificant and one is significant at the 10 percent level. T3 intercept dummy coefficients are positive and significant at the one percent level for half of the 14 models, while the other half are insignificant at the 10 percent level with different signs across the models.

Finally, it should be noted that tax and model interaction variables were examined in several variations of the above models, but these variables were found to have no explanatory power, and therefore were not considered further in this analysis.

The regression results from Models 1, 2, and 3 indicate that manufacturer dummies provide as much information on either the slope or intercept term as any combination of model dummies on the slope and intercept terms, and thus allow a reduction in the dimensionality of the nonlinear problem. Tax dummies have important simultaneous effects on both intercept and slope terms. D1, SF, and GFI also account for important effects in the used asset price equations. Estimation results from various equations based on Model 3 also provide starting values for Model 4.

Results from Model 4

The parameters of Model 4, as presented in equation (5.10), were estimated using the parameter estimates of Models 1, 2, and 3, as starting values. The estimated equation included manufacturing dummy variables on either the slope or intercept term in the exponential portion of the equation and included tax dummies on both the intercept and slope terms of the exponential. D1, SF, and GFI were also included in the exponential, but only on the intercept term. Two versions of Model 4 are thus estimated using equation (5.10) in which an additive error term is assumed. Inspection of the residuals from the estimated equations indicate possible presence of heteroscedasticity as is shown in Figures 1 and 2. This implies that there is probably a multiplicative error structure in terms of the level of price variables instead of the assumed additive error structure. Thus equation (5.12), the natural log equation based on Model 4, is also estimated.

Parameter estimates and statistical results for the four estimated equations of Model 4 are presented in Table 2. Equations 4a and 4b are estimated assuming an additive error structure, while equations 4c and 4d are estimated assuming a multiplicative error structure. Equations 4a and 4c are estimated with manufacturing dummy variables on the intercept term, ϕ , while equations 4b and 4d are estimated with the manufacturing dummy variables located on the slope term, θ .

Major empirical results obtained from the four different

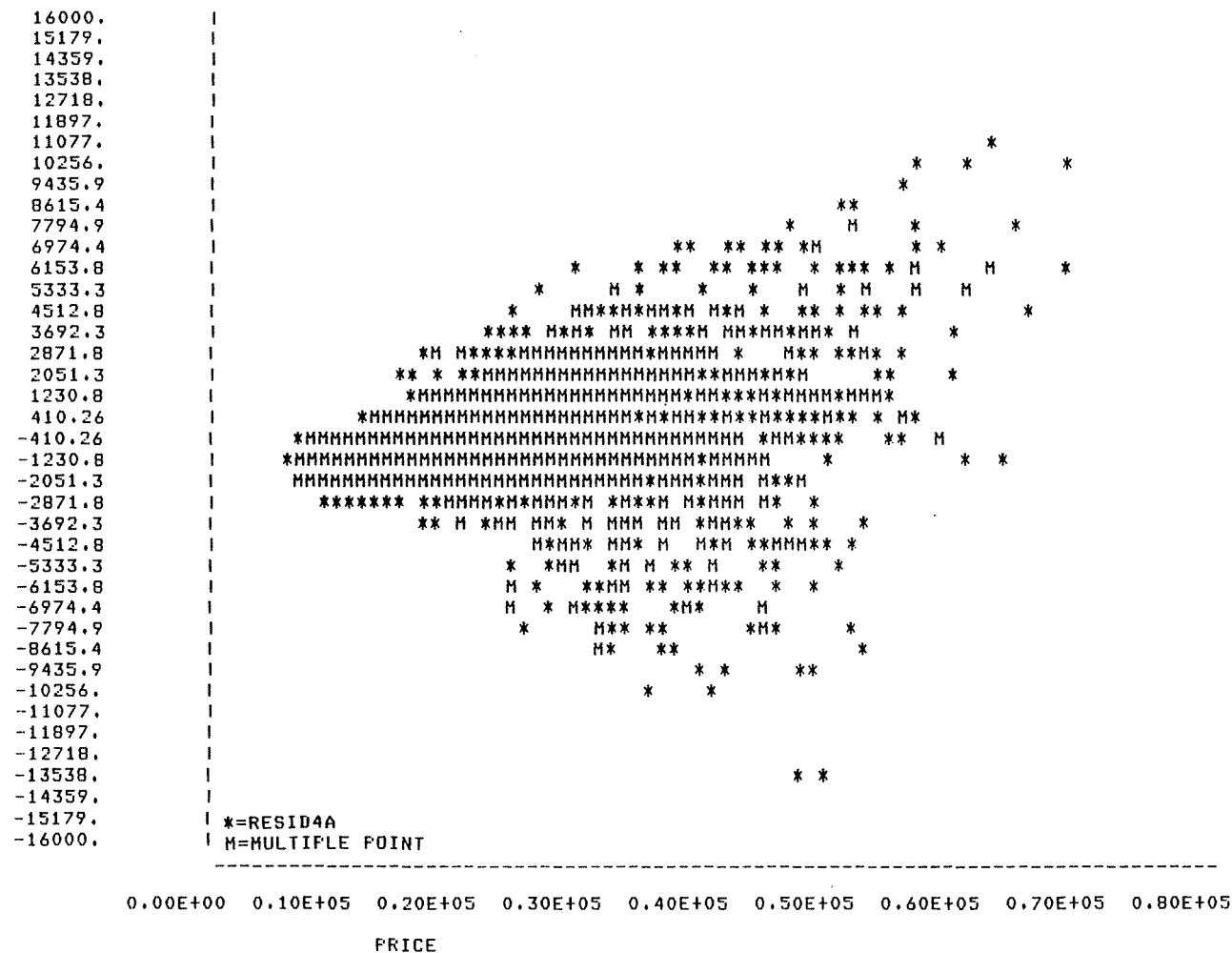


Figure 1. Model 4a residual plot, where RESID4A equals one of the 2323 residual points from equation 4a.

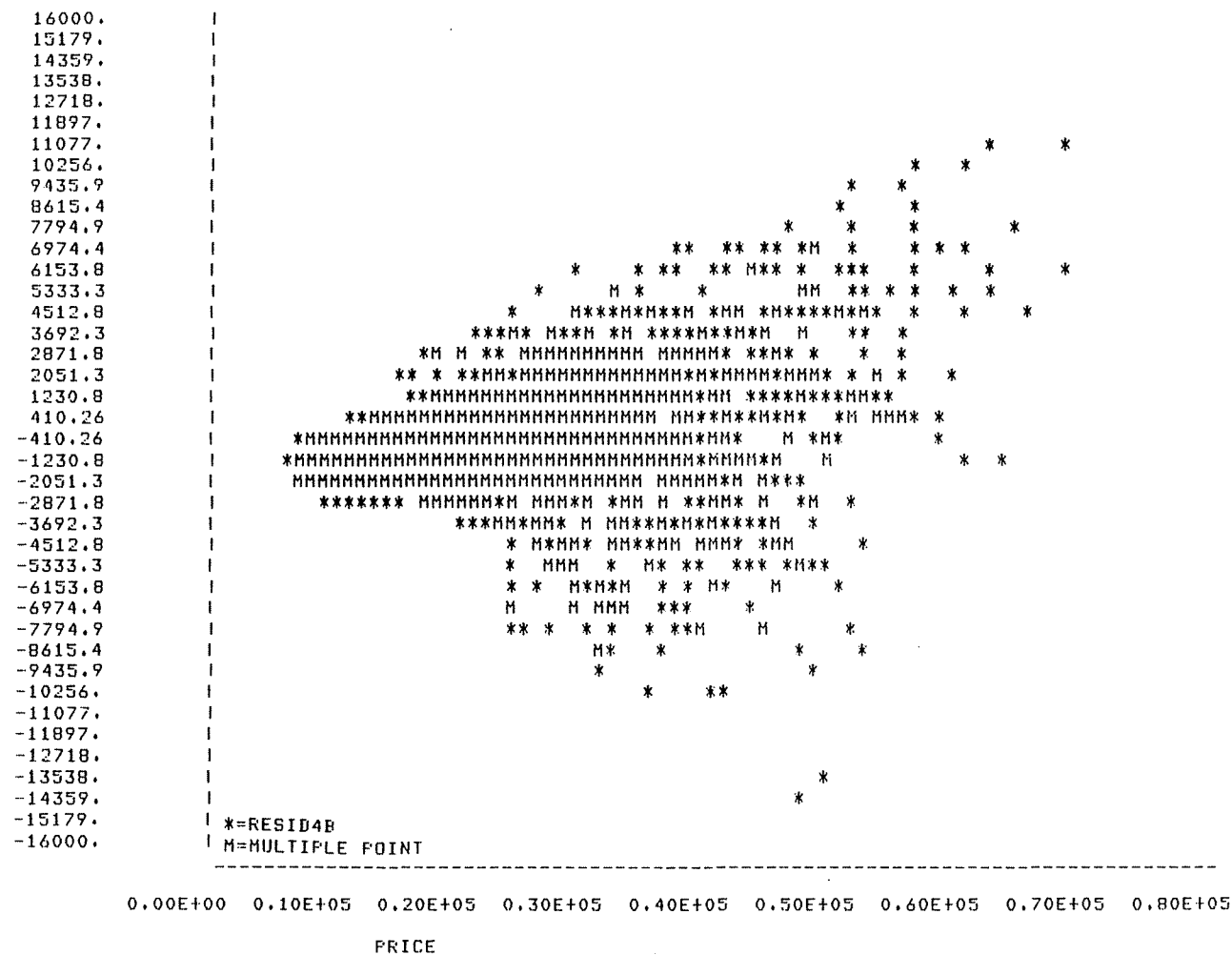


Figure 2. Model 4b residual plot, where RESID4B equals one of the 2323 residual points from equation 4b.

Table 2. Model 4 results.

Variable	Model 4a	Model 4b	Model 4c	Model 4d
δ	7475.9 (12.38) *	7514.2 (12.68)	1346.2 (2.077)	1658.8 (2.591)
D1	-.3432 (-40.60)	-.34361 (-41.18)	-.33132 (-37.88)	-.33209 (-38.45)
ϕ_o	-.5863 (-14.78)	-.56918 (-14.91)	-.33644 (-12.18)	-.32648 (-12.04)
GFI	.00994 (15.28)	.00988 (15.18)	.00513 (11.06)	.00520 (11.15)
T1	.05862 (4.420)	.06247 (4.686)	.00068 (.0609)	.00365 (.3287)
T2	-.14239 (-8.914)	-.13911 (-8.638)	-.12490 (-9.549)	-.12393 (-9.542)
T3	-.01468 (.7201)	-.00282 (-.1434)	-.01054 (.7139)	.01494 (1.011)
M1	.01677 (1.565)		.00587 (.8315)	
M2	.06169 (5.685)		.04948 (6.776)	
M3	.00782 (.7400)		.01440 (2.192)	
M4	.00024 (.0228)		.00535 (.8055)	
M5	-.00623 (-.5875)		.00390 (.5815)	
S	-.02670 (-8.740)	-.03119 (-8.613)	.04947 (-7.842)	-.01759 (-8.430)
T1(S)	.00291 (.9280)	.00252 (.81417)	.00566 (3.111)	.00545 (3.021)
T2(S)	.03707 (10.94)	.03715 (11.10)	.02197 (11.53)	.02227 (11.78)
T3(S)	.03858 (10.24)	.03715 (10.78)	.01487 (8.067)	.01502 (8.172)
M1(S)		.00301 (1.155)		.00016 (.1516)
M2(S)		.01338 (5.186)		.00785 (7.089)
M3(S)		.00230 (.8518)		.00265 (.00087)

Table 2.--Continued

Variable	Model 4a	Model 4b	Model 4c	Model 4d
M4(S)		.00382 (1.568)		.00181 (1.952)
M5(S)		-.00195 (-.7750)		.00136 (1.474)
FS	-.01774 (.0044)	-.01769 (-3.974)	-.00560 (-1.701)	-.00594 (-1.794)
LOG-LIKELIHOOD FUNCTION				
	-21354.22	-21369.04	2723.331	2720.384
MAXIMUM LIKELIHOOD ESTIMATE OF SIGMA SQUARED				
	5650000	5722500	.0056137	.005628

*T-Ratios are contained in parentheses.

estimation equations for Model 4 are as follows. First, for each estimation equation, the age coefficients are negative and significant at the one percent level. Second, the constant term, δ , is negative and significant. Thus the null hypothesis that economic depreciation takes place at a constant rate is rejected.

Different tax regimes also have statistically significant effects on the rate and pattern of depreciation, and therefore the second hypothesis is also strongly rejected. For example, the coefficients for T2 intercept dummies (1985-86) are negative and significant at the one percent level in all four models, while T2 (1985-86) and T3 (1987-89) slope dummy coefficients are positive and significant at the one percent level. Results are mixed in the case of the other two tax intercept dummies (T1 and T3) and the T1 slope dummy coefficients. For example, the T1 intercept and slope dummy

coefficients are positive in all four equations; but both T1 intercept and slope dummy coefficients are significant at the one percent level in only two of the four equations, while the T3 intercept dummy coefficients are not significant at the 10 percent level with different signs across the four equations.

In each estimation equation based on Model 4, the real gross farm income coefficient is positive and significant at the one percent level, while the list price dummy variable is negative and significant at the one percent level. These results are as expected.

The manufacturer intercept and slope dummies, in general, are not significant. M2 (John Deere) is the only exception. The coefficient associated with M2 is positive and significant at the one percent level on the slope or intercept of every model in which it is included.

The coefficients associated with the spring/fall dummy variables are negative and significant at the 10 percent level. In the additive error structure equations, 4a and 4b, the spring/fall dummy variables are, however, significant at the one percent level. Moreover the signs of the coefficients in these regressions are also more realistic, implying a real discount rate for six months of about 1.77 percent.

The plotted regression residual results from equations 4c and 4d indicate that the heteroscedasticity problems in equations 4a and 4b appear to have been ameliorated through the use of a multiplicative error structure in equations 4c

and 4d. Residual plots for equations 4c and 4d are presented in Figure 3 and 4.

Implications of Results

Empirical evidence provided here indicates that rates of depreciation are not constant across different ages of combine harvesters. The evidence also suggests that depreciation rates are not stable with respect to major changes in the tax code. Figure 5 illustrates the behavior of the rate of economic depreciation for a representative combine under each of the four tax regimes when GFI is set at its mean.

In Figure 5, the rate of economic depreciation (the absolute value of the percentage change in the combine harvester's price as it ages one year) is measured on the vertical axis and combine harvester age on the horizontal axis. If the depreciation rate were constant across ages, the depreciation curve would be flat (parallel to the horizontal axis). None of the four depreciation curves in Figure 5 conform to this pattern. Under the 1979-81 and 1982-84 tax regimes, depreciation sharply diverges from this pattern. For the 1979-81 regime, the depreciation rate increases from an initial rate of about 12 percent to a maximum of 17 percent in the eleventh year before declining. Under the 1985-86 regime, the initial depreciation rate is 22.75 percent. It steadily declines by about one percent per year until year 12 and thereafter declines more slowly. These three depreciation

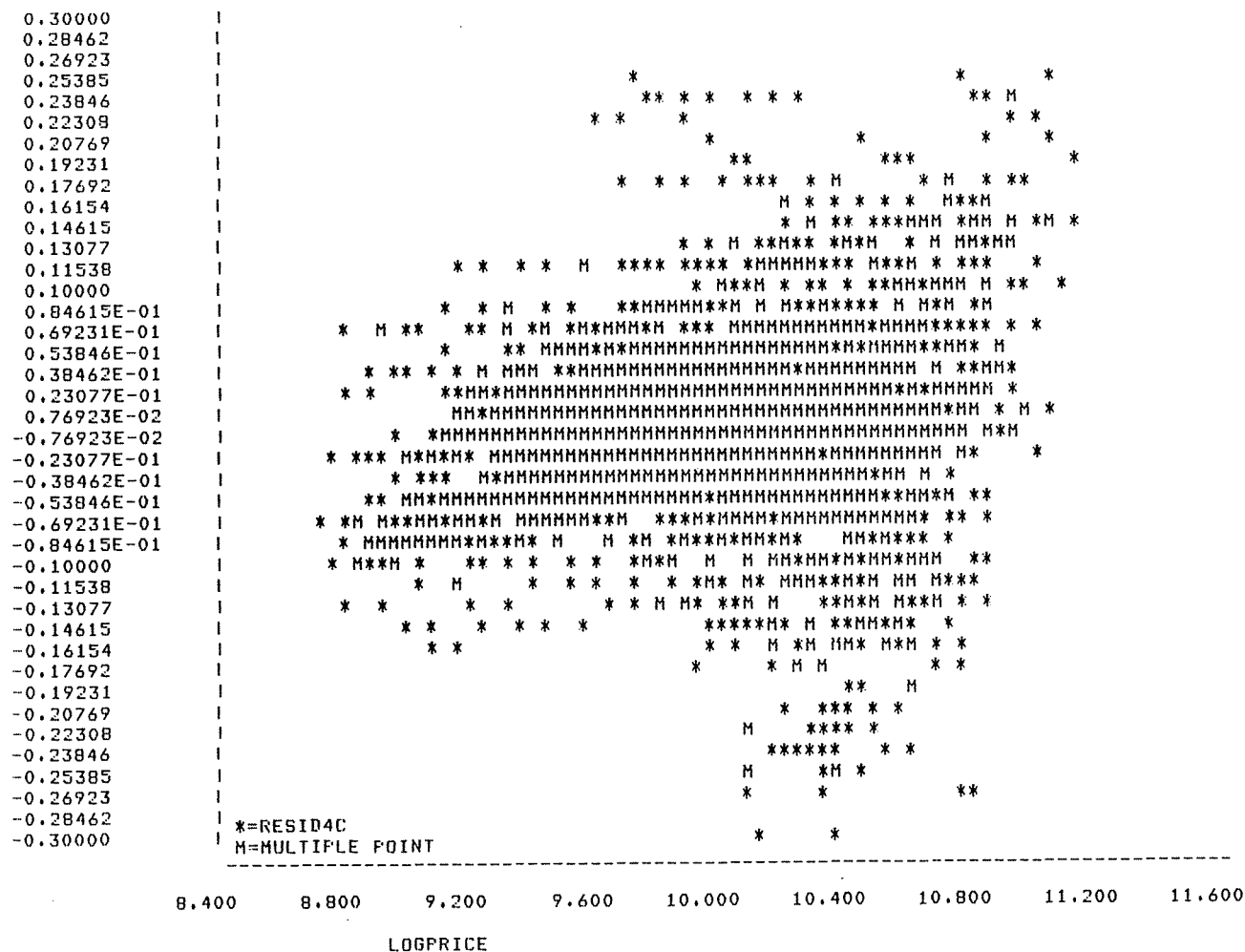


Figure 3. Model 4c residual plot, where RESID4C equals one of the 2323 residual points from equation 4c.

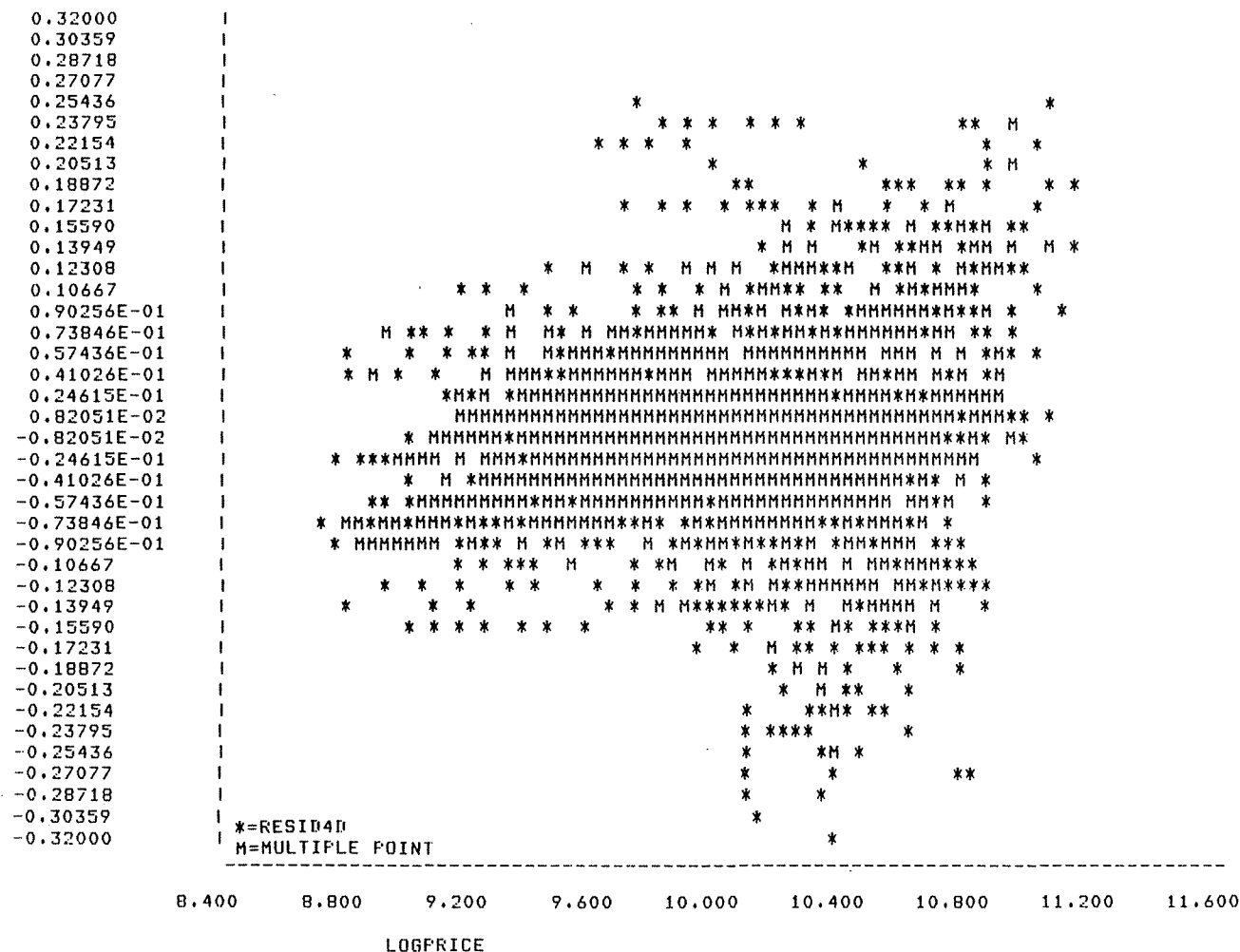


Figure 4. Model 4d residual plot, where RESID4D equals one of the 2323 residual points from equation 4d.

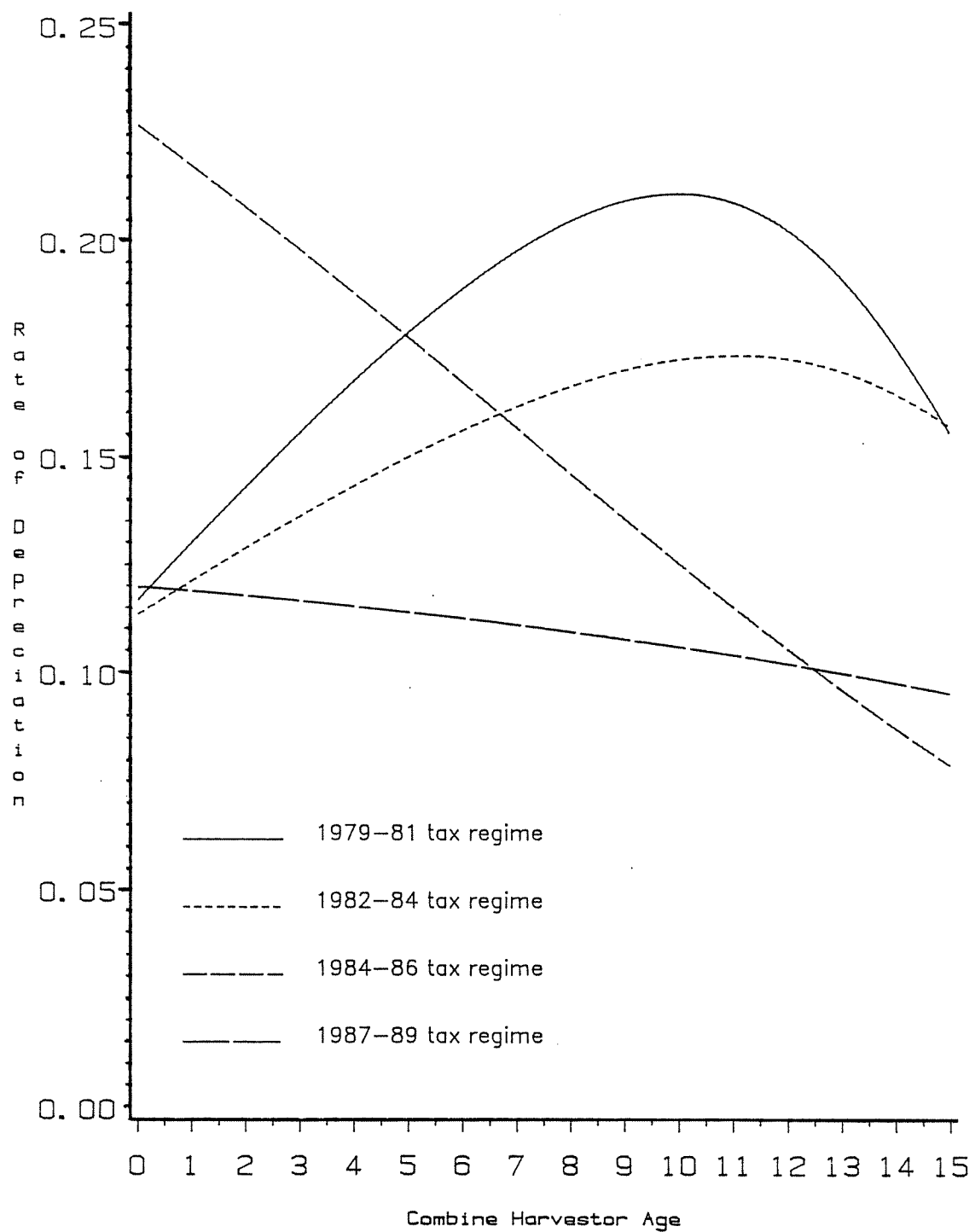


Figure 5. Combine harvester depreciation rates under alternative tax regimes.

patterns in no way correspond to the pattern associated with a constant rate of depreciation. Under the most recent tax structure (1987-89), the rate of depreciation is initially 12percent and thereafter declines by about .15 percentage points each year over the first 15 years of life. In this case, the depreciation pattern is much closer to the constant rate. It is interesting to note that under the 1987-89 tax regime created by the Tax Reform Act (TRA), the benefits obtained from depreciation allowances and investment tax credits are much lower than under the other tax regimes.

These findings imply that studies of depreciation that ignore tax effects should be interpreted with caution. Studies that use remaining value functions based on asset price data in order to estimate the effects of changes in the tax code on optimal replacement rates are also problematic in that the remaining value function is assumed to be exogenous. This study, however, indicates that remaining value functions are in fact affected by the tax regime in which the remaining value function is observed. This means that the optimal replacement problem can no longer be solved using conventional methods.

These results offer further important ramifications. Hulten and Wykoff (1981) conclude that depreciation rates for buildings could be estimated using time-series data with models that do not account for demand and supply shocks and changes in tax regimes. The findings of this study suggest

that their conclusions are not generally valid. In the case of combine harvesters, the pattern of depreciation has been different across time when including age, the demand shocks from real gross farm income from field crops, and changes in the tax regimes between 1979-1989.

The coefficients on the manufacturer dummies implied that technology dummy variables were not an important factor in the used price equation. This, in part, could be explained by the fact that the manner in which the data were selected was intended to minimize the effects on depreciation caused by technological differences.

The list price dummy variable, on the other hand, was an important factor in the used asset price model. One of the objectives of this analysis was to develop a complete used asset price model which started at age zero. However, including the list price without a dummy variable would lead to a serious residual outlier problem. Two approaches to this problem were considered. The first was to omit list price data (Perry and Glyer, 1990), and the second was to include list price data with a dummy variable. A comparison of regression results between these two approaches using estimation equations based on Model 4 appeared to show no major differences in coefficient values after the first year. Thus, the approach including list price data with an instantaneous dummy variable was selected. The list price

dummy variable was, therefore, an important factor in this analysis.

Finally, the spring/fall dummy variable was relatively important in that it indicated fall prices to be lower in real terms relative to spring prices of combine harvesters.

CHAPTER 6

SUMMARY AND CONCLUSIONS

This study developed a used asset price model which is dynamic and utilizes a flexible functional form. An econometric model of used asset prices for combine harvesters was developed. The model incorporates demand shock variables specific to the asset (for example, gross farm income and tax regime dummy variables). The parameters of the specific model were estimated. Tests of the constant economic depreciation rate hypothesis and whether the pattern of depreciation is invariant with respect to changes in the tax code were then carried out. The results of the analysis provide important information about how changes in age, taxes, demand shocks, and technology affect the rate and pattern of economic depreciation in the case of combine harvesters. They also raise important questions about the validity of the conclusions of previous simulation studies of the effects of changes in tax regimes and asset replacement decisions.

The foundation of the theoretical model in this study rests on the assumption that the equilibrium price of an asset is assumed to equal the present value of the net revenue stream it generates. Two important insights were derived from the theoretical model. First, any event that affects net

revenues will also affect asset prices, and secondly, tax regimes have a complex and indirect effect on the net revenue stream. The theoretical results thus suggest that, because of the intricate structure of the net revenue stream over the life of an asset, the rate of depreciation will not necessarily be constant across ages. In addition, changes in tax regimes may have complex effects on net revenue streams and thus the pattern of depreciation is not likely to remain the same when changes are made to the tax code.

Flexible functional forms were used to model the dynamic asset price behavior. The asset price model that was chosen allowed the rate and pattern of depreciation to be flexible by modeling price as an exponential quadratic function of age.

The estimation model is inherently nonlinear. Thus the parameters of three linear models, each of which is nested within the quadratic model, were estimated in order to obtain starting values for and, by screening explanatory variables, reduce the dimensionality of the nonlinear model.

The major empirical results of this study are as follows. First, depreciation rates are not constant across different ages of combine harvesters. Second, depreciation rates and patterns are not stable with respect to changes in tax codes. Third, increases (decreases) changes in real gross farm income from fields crops have significant, positive (negative) effects on combine harvester prices. Fourth, the list price dummy is negative and significant. This suggests that

estimation models that include new machine list prices in the data set should incorporate dummy variables to take into account the instantaneous new list price effect. Finally, the spring/fall dummy variable is also significant, identifying systematic differences between fall and spring prices. These differences can be explained by the interest charge associated with buying an asset approximately six months before it is needed (for example, purchasing a combine harvester in the fall after harvest instead of in the following spring for that summer's use).

The general asset price model used in this study to test the constant rate of economic depreciation hypothesis could be applied to other specific physical assets such as trucks, tractors, and fishing vessels. Data sets on these specific assets have previously been examined, but with models that were based on different functional forms and that were estimated with different procedures.

Finally, this study has shown that used asset prices are in fact affected by changes in tax regimes. Thus remaining value functions based on a given data set include the effects of the tax regime under which the new or used asset prices were generated. The analysis raises questions about the validity of conventional methods used in previous asset replacement studies which assume constant rates of depreciation and do not include taxes as an explanatory variable in the remaining value functions. This study

indicates that new methods must be developed in which this problem is accounted for if the optimal replacement problem is to be solved in an internally consistent manner.

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APPENDICES

APPENDIX A

COMBINE HARVESTER DATA

Table 3. Combine prices.

Year	Year Manufactured						
Model (AC-L2) ¹							
	1982	1981	1980	1979	1978	1977	1976
F89 ²	24410	22520	20771	19154	17658	16274	
S89	23736	21897	20195	18621	17165	15818	
F88	25164	23218	21417	19751	18210	16784	
S88	26969	24886	22960	21179	19530	18006	
F87	28899	26672	24613	22707	20944	19314	
S87	30298	27967	25809	23814	21969	20262	
F86	32638	30131	27811	25666	23681	21845	
S86	35154	32458	29964	27657	25523	23550	
F85	37859	34960	32278	29798	27504	25381	
S85	40768	37651	34768	32101	29634	27352	
F84	43896	40545	37444	34576	31923	29469	
S84	47531	43906	40554	37453	34584	31931	
F83	51307	47400	43786	40443	37349	34488	
S83	52780	48762	45045	41607	38427	35485	
F82	74735	55748	51508	47585	43956	40600	
S82	62734	47736	44096	40729	37615	34734	32069
F81		62734	47736	44096	40729	37615	34734
S81		51743	39235	36232	33456	30887	28511
F80			50581	38335	35400	32685	30175
S80			45335	34309	31676	29241	26989
F79				45335	34663	32004	29544
S79				40459	31194	28795	26576

Model (AC-L3)							
	1985	1984	1983				
F89	26234	24199	22317				
S89	25508	23527	21695				
F88	27044	24948	23010				
S88	28987	26745	24672				
F87	31064	28667	26449				
S87	32570	30060	27738				
F86	35090	32391	29895				
S86	37797	34895	32211				
F85	80771	40709	37589				
S85	79577	43841	40485				
F84		79577	47208				
S84		74706					
F83			80710				

Model (AC-M2)							
	1980	1979	1978	1977	1976		
F89	10663	9811	9022	8293			
S89	10333	9505	8739	8031			
F88	11100	10214	9396	8639			

Table 3.--Continued.

Year	Year Manufactured						
Model (AC-M2)--Continued							
	1980	1979	1978	1977	1976		
S88	12057	11100	10214	9396			
F87	13092	12057	11100	10214			
S87	14051	12944	11920	10974			
F86	15510	14294	13169	12129			
S86	17016	15686	14457	13320			
F85	18661	17209	15865	14622			
S85	20460	18872	17404	16046			
F84	22053	20346	18768	17307			
S84	24071	22213	20494	18904			
F83	26079	24071	22213	20494			
S83	26837	24771	22860	21093			
F82	28362	26182	24166	22300			
S82	29620	27346	25242	23296	21496		
F81	30558	28213	26044	24038	22182		
S81	30558	28213	26044	24038	22182		
F80	40345	30873	28505	26315	24288		
S80	40345	31192	28800	26588	24541		
F79		43167	33423	30864	28496		
S79		36004	28038	25883	23889		

Model (AC-M3)							
	1985	1984	1983				
F89	25485	23517	21697				
S89	24783	22868	21097				
F88	26269	24243	22369				
S88	28418	25980	23976				
F87	30157	27839	25695				
S87	31614	29186	26942				
F86	34050	31440	29026				
S86	32447	29958	27655				
F85	66024	34946	32268				
S85	67540	37632	34753				
F84		67540	40520				

Model (AC-N5)							
	1985	1984	1983	1982	1981	1980	1979
F89	35318	32603	30092	27769	25620	23633	21794
S89	34350	31708	29264	27003	24912	22977	21188
F88	36400	33604	31017	28625	26412	24365	22471
S88	38992	36002	33236	30677	28310	26121	24096
F87	41764	38565	35607	32870	30339	27997	25832
S87	43773	40424	37326	34461	31810	29358	27090
F86	47134	43533	40202	37120	34270	31634	29195
S86	46071	42550	39292	36279	33492	30914	28530

Table 3.--Continued.

[illegible]

Table 3.--Continued.

Year	Year Manufactured								
Model (JD-7700)									
	1978	1977	1976	1975	1974	1973	1972	1971	1970
F89	16697	15286							
S89	15938	14588							
F88	16283	14906	13638						
S88	16921	15492	14177						
F87	17961	16448	15057	13777					
S87	18956	17364	15899	14552					
F86	20226	18533	16975	15541	14223				
S86	21339	19556	17917	16408	15020				
F85	22027	20190	18499	16943	15513	14196			
S85	24279	22254	20392	18678	17102	15652			
F84	23470	21517	19720	18067	16546	15147	13860		
S84	25729	23596	21633	19827	18165	16637	15231		
F83	26579	24378	22352	20489	18774	17197	15746	14411	
S83	27069	24829	22768	20871	19126	17521	16043	14685	
F82	27656	25369	23264	21328	19546	17907	16399	15012	13736
S82	28863	26479	24285	22267	20411	18702	17130	15685	14354
F81	30105	27621	25336	23234	21301	19521	17884	16378	14973
S81	30105	27621	25336	23234	21301	19521	17884	16378	14973
F80	30261	27765	25468	23355	21411	19623	17978	16464	15072
S80	30418	27909	25602	23478	21525	19728	18075	16553	15154
F79	32078	29429	26993	24752	22689	20792	19047	17442	15964
S79	30733	28199	25868	23723	21750	19935	18264	16728	15314
	-	-	-	-	-	-	-	-	-
Model (JD-7720)									
	1988								
F89	52203								
S89	48391								
F88	83077								
S88	83077								
	1987	1986	1985	1984	1983	1982	1981	1980	1979
F89	48488	45034	41821	38833	36054	33470	31067	28831	26752
S89	44943	41737	38755	35981	33402	31004	28773	26699	24769
F88	48315	44872	41670	38693	35924	33348	30953	28726	26654
S88	44745	41552	38583	35822	33254	30865	28644	26579	24658
F87	83077	47272	43903	40769	37854	35143	32623	30279	28098
S87	83077	46915	43570	40460	37567	34877	32376	30049	27885
F86		83077	49696	46157	42866	39805	36958	34310	31848
S86		84777	52078	48372	44925	41720	38739	35966	33388
F85			84777	53159	49377	45860	42589	39547	36718
S85			82713	54261	50402	46813	43476	40372	37485
F84				82713	55386	51448	47787	44381	41213
S84				78240	52344	48620	45156	41934	38938
F83					84737	61083	56746	52714	48964
S83					78371	58518	54361	50495	46900

Table 3.--Continued.

Year	Year Manufactured								
Model (IH-915)									
	1979	1978	1977	1976	1975	1974	1973	1972	1971
F89	11348	10188	9138						
S89	10851	9738	8731						
F88	11245	10095	9053	8112					
S88	12520	11248	10097	9056					
F87	13605	12231	10986	9860	8841				
S87	14529	13067	11744	10546	9462				
F86	15777	14196	12765	11471	10299	9238			
S86	16933	15243	13713	12328	11074	9940			
F85	18170	16362	14726	13244	11904	10691	9593		
S85	19493	17559	15809	14224	12791	11494	10320		
F84	20677	18631	16779	15102	13585	12212	10970	9845	
S84	23202	20915	18847	16974	15279	13746	12358	11101	
F83	25013	22555	20330	18316	16494	14845	13352	12002	10779
S83	25813	23278	20985	18909	17031	15331	13792	12400	11140
F82	27516	24820	22379	20171	18173	16364	14727	13245	11905
S82	28931	26100	23539	21221	19123	17224	15505	13950	12542
F81	30172	27223	24555	22140	19955	17977	16187	14567	13101
S81	30172	27223	24555	22140	19955	17977	16187	14567	13101
F80	30486	27507	24812	22372	20165	18167	16359	14723	13243
S80	30802	27794	25071	22607	20377	18360	16533	14880	13384
F79	42330	30685	27688	24976	22521	20229	18289	16469	14823
S79	42330	30843	27831	25105	22638	20405	18384	16556	14901
	1970	1969							
F82	11269								
S82	10692								
F81	11774	10573							
S81	11774	10573							
F80	11902	10689							
S80	12030	10806							
F79	13333	11984							
S79	13403	12047							

Model (IH-1440)									
	1985	1984	1983	1982	1981	1980	1979	1978	
F89	36512	33710	31119	28722	26504	24453	22556	20800	
S89	35819	32519	29516	26784	24297	22035	19975	18101	
F88	34332	31165	28285	25663	23277	21106	19131	17333	
S88	30592	27762	25187	22845	20713	18772	17007	15400	
F87	32958	29916	27147	24628	22335	20249	18350	16622	
S87	34737	31534	28620	25968	23554	21358	19360	17541	
F86	37210	33785	30668	27832	25251	22902	20765	18820	
S86	33696	30928	28383	26040	23885	21902	20078		
F85	73985	41769	37933	34443	31267	28377	25747	23353	
S85	73740	44249	40190	36497	33136	30078	27295	24762	

Table 3.--Continued.

Year	Year Manufactured							
Model (IH-1440)--Continued								
	1985	1984	1983	1982	1981	1980	1979	1978
F84		73740	46873	42578	38669	35113	31877	28932
S84		64825	41035	37265	33835	30714	27874	25289
F83			69745	50073	45491	41321	37525	34072
S83			69745	51648	46924	42624	38712	35151
F82				69745	54999	49973	45399	41236
S82				59493	41939	38089	34584	31395
F81					59663	43722	39711	36061
S81					59493	43722	39711	36061
F80						56456	34940	31719
S80						56456	35301	32048
F79							48260	
S79							48260	
	-	-	-	-	-	-	-	-
Model (IH-1460)								
	1985	1984	1983	1982	1981	1980	1979	1978
F89	40906	37140	33713	30594	27756	25174	22823	20685
S89	40154	36456	33090	30027	27240	24704	22396	20295
F88	39517	35875	32562	29547	26803	24304	22035	19967
S88	36329	32975	29923	27145	24617	22317	20224	18319
F87	39134	35527	32246	29259	26541	24068	21817	19768
S87	41244	37448	33992	30848	27987	25384	23015	20859
F86	44176	40116	36421	33058	29998	27214	24680	22374
S86	46801	42505	38595	35037	31799	28853	26171	23731
F85	85700	49580	45033	40896	37130	33704	30586	27749
S85	85260	51960	47199	42867	38924	35337	32072	29101
F84		85260	54452	49467	44931	40802	37045	33626
S84		74375	47515	43154	39185	35574	32288	29297
F83			79495	56762	51568	46842	42542	38629
S83			79495	58546	53192	48319	43886	39852
F82				79495	62343	56647	51464	46748
S82				67443	48238	43812	39785	36119
F81					67443	50286	45676	41480
S81					67443	50286	45676	41480
F80						63406	38853	35272
S80						63406	39255	35637
F79							53665	
S79							53665	

Table 3.--Continued.

Year	Year Manufactured								
Model (MF-550)									
	1988	1987							
F89	30308	27680							
S89	29628	27058							
F88	57480	29536							
S88	57480	29120							
F87		57480							
S87		57480							
	1986	1985	1984	1983	1982	1981	1980	1979	1978
F89	25276	23075	21061	19219	17534	15991	14580	13289	12107
S89	24706	22554	20584	18782	17133	15625	14244	12981	11826
F88	26973	24628	22483	20519	18723	17079	15575	14199	12940
S88	26593	24280	22165	20228	18457	16836	15353	13995	12753
F87	31018	28330	25870	23619	21559	19675	17950	16373	14929
S87	28724	26230	23949	21861	19951	18204	16604	15140	13801
F86	57480	30763	28096	25656	23423	21379	19510	17800	16235
S86	60012	29258	26719	24396	22270	20326	18546	16917	15427
F85		60012	31335	28619	26134	23861	21781	19878	18136
S85		58091	33556	30651	27994	25562	23337	21301	19439
F84			58091	35931	32825	29982	27381	25002	22825
S84			54806	34097	31147	28447	25977	23717	21649
F83				60331	42981	39275	35885	32782	29943
S83				57939	39808	36372	33228	30351	27720
F82					55126	39689	36263	33128	30260
S82					54526	39713	36285	33149	30279
F81						54526	39713	36285	33149
S81						51838	37726	34467	31485
F80							48904	35140	32101
S80							44097	31675	28930
F79								41198	
S79								37329	

Model (MF-750)									
	1980	1979	1978	1977	1976	1975	1974	1973	
F89	16631	15076	13662	12374					
S89	16210	14694	13314	12057					
F88	17676	16027	14527	13161	11919				
S88	19054	17281	15668	14200	12864				
F87	20537	18631	16896	15318	13881	12574			
S87	21652	19645	17819	16158	14646	13269			
F86	23202	21055	19103	17326	15709	14238	12899		
S86	24859	22564	20475	18575	16845	15271	13838		
F85	26631	24176	21942	19910	18060	16377	14846	13452	
S85	28526	25902	23512	21338	19360	17560	15922	14431	
F84	30554	27746	25191	22866	20751	18825	17073	15479	
S84	33152	30111	27343	24825	22532	20446	18548	16821	

Table 3.--Continued.

Year	Year Manufactured							
Model (MF-750)--Continued								
	1980	1979	1978	1977	1976	1975	1974	1973
F83	35991	32694	29693	26963	24479	22218	20160	18287
S83	37027	33637	30551	27744	25188	22864	20748	18823
F82	39219	35632	32367	29396	26692	24232	21993	19956
S82	41098	37341	33922	30811	27981	25404	23060	20927
F81	42837	38924	35363	32123	29174	26491	24049	21827
S81	42837	38924	35363	32123	29174	26491	24049	21827
F80	57886	42660	38763	35217	31989	29053	26380	23948
S80	51797	38106	34618	31444	28557	25929	23538	21362
F79		48394	35560	32302	29337	26639	24184	21949
S79		43084	31954	29021	26351	23922	21711	19699

Model	(MF-760)								
	1980	1979	1978	1977	1976	1975	1974	1973	1972
F89	19813	17972	16296	14772					
S89	19315	17519	15884	14396					
F88	20817	18885	17128	15529	14073				
S88	22187	20132	18262	16561	15013				
F87	23644	21458	19469	17660	16012	14514			
S87	24922	22621	20528	18623	16889	15311			
F86	26699	24239	22000	19962	18108	16420	14884		
S86	28599	25968	23583	21393	19410	17606	15963		
F85	30632	27817	25256	22926	20805	18875	17118	15519	
S85	32805	29795	27055	24562	22293	20229	18350	16641	
F84	35130	31910	28980	26314	23888	21680	19671	17843	16179
S84	38942	35380	32138	29188	26503	24060	21836	19813	17972
F83	42267	38406	34891	31693	28783	26134	23725	21532	19536
S83	43480	39509	35896	32607	29614	26891	24413	22158	20106
F82	46048	41846	38022	34542	31376	28494	25872	23486	21314
S82	48248	43848	39843	36199	32883	29866	27120	24621	22348
F81	50285	45701	41531	37735	34281	31138	28277	25675	23306
S81	50285	45701	41531	37735	34281	31138	28277	25675	23306
F80	65218	50090	45524	41369	37588	34147	31016	28167	25574
S80	59314	44642	40567	36858	33483	30412	27617	25074	22759
F79		55418	41464	37675	34226	31088	28232	25634	23269
S79		49043	36852	33478	30407	27612	25069	22755	20649

Table 3.--Continued.

Year	Year Manufactured							
Model (MF-850)								
	1988	1987	1986	1985	1984	1983	1982	
F89	39522	36315	33364	30649	28152	25854	23741	
S89	38641	35505	32619	29963	27520	25273	23206	
F88	74639	38547	35417	32538	29889	27452	25211	
S88	74639	38038	34949	32107	29492	27088	24875	
F87		74639	40502	37216	34193	31412	28853	
S87		74639	36903	33905	31147	28609	26275	
F86			74639	39508	36302	33352	30638	
S86			77927	35778	32870	30195	27733	
F85				77927	38304	35194	32333	
S85				76924	41006	37680	34620	
F84					76924	43896	40339	
S84					73555	42403	38964	
F83						79258		
S83						72220		
F82							72042	
	-	-	-	-	-	-	-	
Model (NH-1500)								
	1980	1979	1978	1977	1976	1975	1974	1973
F89	15343	13821	12443	11196				
S89	14617	13164	11848	10657				
F88	15594	14048	12648	11382	10235			
S88	16726	15072	13575	12220	10995			
F87	17740	15989	14405	12972	11675	10501		
S87	18608	16776	15117	13616	12258	11029		
F86	19840	17890	16125	14528	13083	11775	10591	
S86	20920	18867	17010	15328	13807	12430	11184	
F85	22056	19895	17940	16171	14569	13120	11809	10622
S85	23253	20979	18921	17059	15373	13848	12467	11218
F84	24513	22119	19952	17991	16218	14612	13158	11843
S84	26717	24113	21757	19625	17696	15950	14370	12939
F83	28858	26051	23511	21213	19133	17250	15546	14004
S83	29772	26878	24259	21890	19745	17804	16048	14459
F82	31459	28405	25641	23141	20877	18829	16975	15297
S82	32885	29696	26809	24197	21833	19694	17758	16006
F81	34283	30962	27955	25234	22772	20543	18526	16701
S81	34283	30962	27955	25234	22772	20543	18526	16701
F80	45925	34459	31121	28099	25364	22890	20650	18623
S80	45889	34636	31280	28243	25495	23008	20757	18721
F79		45889	34814	31441	28389	25627	23127	20865
S79		44600	30368	27418	24748	22332	20145	18167

Table 3.--Continued.

Year	Year Manufactured						
Model (NH-TR70)							
	1980	1979	1978	1977	1976	1975	
F89	17021	15433	13988	10773			
S89	15916	14428	13074	11841			
F88	16972	15388	13948	12636	11443		
S88	18195	16502	14961	13558	12283		
F87	16397	14874	13488	12226	11078	10033	
S87	20229	18352	16645	15091	13677	12390	
F86	21327	19351	17553	15918	14430	13075	
S86	22481	20402	18510	16788	15221	13796	
F85	23697	21508	19516	17704	16055	14554	
S85	24976	22672	20576	18669	16932	15352	
F84	26323	23898	21692	19683	17855	16193	
S84	28908	26250	23832	21631	19629	17806	
F83	31216	28350	25743	23370	21211	19246	
S83	32200	29246	26559	24112	21886	19861	
F82	34018	30900	28063	25482	23132	20995	
S82	35556	32300	29336	26640	24186	21953	
F81	37063	33671	30585	27777	25221	22895	
S81	37063	33671	30585	27777	25221	22895	
F80	49452	37362	33954	30852	28029	25460	
S80	49452	37553	34127	31009	28172	25590	
F79		49452	37744	34300	31167	28316	
S79		49452	33152	30123	27365	24856	
- - - - -							
Model (NH-TR75)							
	1985	1984	1983	1982	1981	1980	1979
F89	34077	31119	28412	25935	23669	21595	19698
S89	32579	29747	27158	24788	22619	20634	18818
F88	34332	31352	28625	26131	23848	21758	19847
S88	36373	33220	30334	27694	25278	23067	21045
F87	38122	34819	31798	29033	26503	24188	22070
S87	39531	36109	32977	30113	27492	25093	22898
F86	41650	38048	34751	31736	28977	26452	24142
S86	43880	40088	36618	33444	30539	27881	25449
F85	79069	46228	42236	38584	35243	32186	29388
S85	79069	48699	44497	40653	37136	33918	30973
F84		79069	51028	46628	42602	38919	35549
S84		82393	53336	48741	44536	40689	37168
F83			82393	57405	52464	47943	43806
S83			76758	53678	49053	44822	40950
F82				76758	56692	51811	47345
S82				68493	51085	46682	42652
F81					68395	51017	46619
S81					65775	48786	44578
F80						59781	
S80						57271	

Table 3.--Continued.

Year	Year Manufactured						
Model (NH-TR85)							
	1985	1984	1983	1982	1981	1980	1979
F89	37853	34574	31568	28820	26306	24006	21901
S89	32579	29747	27158	24788	22619	20634	18818
F88	38136	34830	31805	29038	26506	24188	22068
S88	40400	36901	33700	30771	28091	25639	23395
F87	42339	38676	35324	32258	29452	26884	24534
S87	43903	40106	36633	33455	30547	27887	25452
F86	46253	42257	38601	35255	32195	29394	26831
S86	48726	44520	40671	37150	33927	30979	28282
F85	85683	51057	46653	42623	38935	35562	32475
S85	85683	53499	48886	44667	40806	37274	34041
F84		85683	56054	51226	46807	42764	39065
S84		88655	58116	53112	48533	44343	40510
F83			88655	62547	57166	52243	47738
S83			82949	58703	53649	49024	44793
F82				82949	61998	56663	51782
S82				75033	56605	51730	47268
F81					75111	56706	51822
- - - - -							
Model (WHITE-8600)							
	1977	1976	1975	1974			
F89	8807						
S89	8437						
F88	9133	8238					
S88	9998	9024					
F87	10938	9880	8918				
S87	11622	10503	9484				
F86	12558	11354	10260	9263			
S86	13564	12270	11093	10021			
F85	14646	13254	11989	10837			
S85	15809	14313	12951	11713			
F84	17059	15451	13987	12655			
S84	18601	16853	15263	13816			
F83	20174	18286	16567	15003			
S83	20823	18875	17103	15491			
F82	22203	20132	18246	16531			
S82	23288	21119	19145	17349			
F81	24292	22032	19976	18105			
S81	24292	22032	19976	18105			
F80	24545	22263	20186	18297			
S80	24801	22496	20398	18489			
F79	25059	22731	20612	18684			
S79	25189	22849	20720	18782			

Table 3.--Continued.

Year	Year Manufactured			
Model (WHITE-8800)				
	1977	1976	1975	1974
F89	9892			
S89	9478			
F88	10259	9255		
S88	11229	10137		
F87	12283	11097	10017	
S87	13051	11795	10653	
F86	14101	12751	11523	10405
S86	15229	13777	12456	11254
F85	16443	14882	13462	12170
S85	17748	16070	14542	13152
F84	19151	17346	15704	14210
S84	20762	18813	17039	15424
F83	22518	20411	18493	16748
S83	23242	21069	19092	17293
F82	24782	22471	20368	18454
S82	25992	23572	21369	19365
F81	27112	24591	22297	20209
S81	27112	24591	22297	20209
F80	27395	24848	22531	20422
S80	27681	25109	22768	20638
F79	27970	25371	23007	20856
S79	28115	25504	23128	20966

Model (WHITE-8900)				
	1981	1980	1979	1978
F89	21219	19230	17421	15774
S89	20369	18457	16717	15133
F88	21726	19692	17841	16156
S88	23428	21241	19250	17439
F87	25257	22905	20765	18817
S87	26489	24026	21785	19746
F86	28235	25616	23231	21061
S86	30093	27306	24769	22462
F85	32069	29104	26406	23951
S85	34172	31018	28147	25535
F84	36409	33053	29999	27221
S84	38694	35133	31892	28942
F83	41902	38052	34549	31360
S83	43225	39255	35643	32356
F82	46039	41816	37974	34477
S82	48250	43828	39805	36144
F81	59613	42269	38386	34853
S81	59613	42269	38386	34853
F80		59613	42705	38782
S80		55363	39659	36011

Table 3.--Continued.

Year		Year Manufactured	
Model (WHITE-8900)--Continued			
	1981	1980	1979 1978
F79			48036
S79			48036

(1) YEAR (F89) means fall data from 1989.

(2) AC Allis-Chalmers
 JD John Deere
 IH International Harvester
 MF Massey-Ferguson
 NH New Holland
 WHITE White

APPENDIX B

RESULTS FROM MODELS 1, 2, AND 3

Table 4. Model 1 results.

Variable	Model 1a	Model 1b	Model 1c	Model 1d
β_0	.68664 (75.58)	.59788 (26.24)	.68140 (50.81)	.60335 (26.20)
D1(P)	-.22887 (-62.47)	-.22190 (-64.60)	-.23174 (-61.11)	-.22517 (-63.35)
SF(P)	-.01019 (-3.021)	-.01060 (-3.400)	-.01082 (-3.376)	-.01134 (-3.813)
GFI(P)	.00435 (21.84)	.00580 (14.76)	.00470 (21.17)	.00604 (16.03)
T1(P)		.03062 (-3.400)		.02110 (3.538)
T2(P)		-.01984 (-2.424)		-.02579 (-3.266)
T3(P)		.07604 (7.259)		.07012 (6.953)
M1(P)			-.45383 (-2.515)	-.02996 (-1.784)
M2(P)			-.01129 (-1.097)	-.00649 (-.6788)
M3(P)			.02609 (2.554)	.02302 (2.426)
M4(P)			.00503 (.4844)	.00980 (1.018)
M5(P)			-.02494 (-1.380)	-.02796 (-2.648)
M6(P)			-.05796 (-4.634)	-.06372 (-5.460)
M7(P)			-.01321 (-1.239)	-.00747 (-.7553)
M8(P)			-.00623 (-.5630)	.00113 (.1142)
M9(P)			.03126 (2.856)	.03285 (3.238)
M10(P)			-.08051 (-5.304)	-.02607 (-4.429)
M11(P)			-.04585 (-3.176)	-.04520 (-3.373)
M12(P)			.02230 (2.084)	.02034 (2.046)
M13(P)			-.01796 (-1.333)	-.01590 (-1.272)
M14(P)			-.05823 (-3.995)	-.05767 (-4.263)
M15(P)			-.05704 (-4.221)	-.05639 (-4.496)
M16(P)			-.00193 (-.1776)	.00290 (.2868)
M17(P)			-.00816 (-.7025)	-.00676 (-.6276)

Table 4.--Continued.

Variable	Model 1a	Model 1b	Model 1c	Model 1d
M18 (P)			-.007526 (-.6949)	-.00629 (-.6259)
M19 (P)			-.04340 (-3.420)	-.04235 (-3.619)
M20 (P)			-.04149 (-3.339)	-.04094 (-3.549)
M21 (P)			-.03677 (-1.982)	-.03424 (-1.990)
M22 (P)			-.03628 (-2.127)	-.03372 (-.0445)

Variable	Model 1e	Model 1f		
β_0	.67418 (56.39)	.59424 (25.33)		
D1 (P)	-.23112 (-63.57)	-.22415 (-65.68)		
SF (P)	-.01050 (-3.157)	-.01100 (-3.545)		
GFI (P)	.00456 (22.82)	.00588 (15.05)		
T1 (P)		.02860 (4.683)		
T2 (P)		-.22582 (-2.791)		
T3 (P)		.07101 (6.848)		
M1 (P)	.00290 (.3586)	.00665 (.8816)		
M2 (P)	.03202 (3.930)	.02909 (3.823)		
M3 (P)	.00158 (.1956)	.00414 (.5494)		
M4 (P)	-.00793 (-.9835)	-.00970 (-1.292)		
M5 (P)	-.00655 (-.8170)	-.00325 (-.4352)		

Table 5. Model 2 results.

Variable	Model 2a	Model 2b	Model 2c	Model 2d
θ_o	854.80 (5.721)	-1698.8 (-6.502)	627.69 (2.874)	-1904.5 (-6.374)
β_o	.64969 (58.55)	.54762 (37.99)	.63157 (55.67)	.53139 (36.95)
D1(P)	-.21478 (-48.89)	-.22338 (-52.86)	-.21268 (-48.75)	-.22227 (-52.73)
SF(P)	-.00941 (-2.806)	-.01117 (-3.545)	-.00938 (-2.841)	-.01121 (-3.609)
GFI(P)	.00456 (22.67)	.00740 (23.29)	.00480 (23.79)	.00765 (24.34)
T1		1819.8 (8.757)		1918.9 (9.350)
T2		1215.6 (4.758)		-1338.3 (5.286)
T3		3653.3 (.2629)		3731.4 (13.45)
M1			595.64 (2.491)	245.05 (1.082)
M2			1552.4 (6.490)	1334.8 (5.916)
M3			247.66 (1.136)	245.59 (1.199)
M4			190.24 (.8521)	-43.411 (-.2063)
M5			177.30 (.7819)	-45.412 (-.2126)

Variable	Model 2e	Model 2f	Model 2g	Model 2h
θ_o	4234.1 (12.32)	3361.6 (7.144)	4621.5 (13.64)	2173.2 (4.121)
β_o	.42498 (29.23)	.40319 (25.60)	.46193 (21.81)	.51567 (22.27)
D1(P)	-.17937 (-42.11)	-.17806 (-38.53)	-.16876 (-40.46)	-.17781 (-40.08)
SF(P)	-.00820 (-2.739)	-.00869 (-3.006)	-.00874 (-3.143)	-.01002 (-3.655)
GFI(P)	.00734 (32.15)	.00788 (26.37)	.00643 (18.05)	.00640 (18.49)
T1		1366.3 (7.041)		866.81 (2.293)
T2		-165.79 (-.6611)		3061.8 (7.740)
T3		1169.8 (3.935)		2040.2 (4.959)
M1	-194.88 (-.3518)	2.9617 (.0055)	315.04 (.6097)	426.32 (.8388)

Table 5.--Continued

Variable	Model 2e	Model 2f	Model 2g	Model 2h
M2	1507.2 (3.888)	1551.8 (4.087)	1801.0 (4.941)	1660.0 (4.609)
M3	3158.0 (8.399)	3204.0 (8.698)	3451.8 (9.651)	3369.5 (9.581)
M4	1651.5 (4.528)	1706.2 (4.826)	1877.0 (5.513)	1826.9 (5.451)
M5	-945.46 (-2.654)	-914.83 (-2.663)	-940.79 (-2.842)	-836.87 (-2.569)
M6	50.437 (.1131)	178.52 (.4110)	478.14 (1.130)	532.11 (1.279)
M7	875.95 (2.306)	930.39 (2.524)	1135.1 (3.199)	1072.5 (3.070)
M8	1516.2 (3.880)	1590.4 (4.174)	1869.6 (5.095)	1819.2 (5.028)
M9	1126.8 (3.100)	1172.9 (3.348)	1187.3 (3.516)	1225.8 (3.692)
M10	-948.27 (-1.752)	-753.26 (-1.437)	-308.92 (-.6106)	-154.52 (-.3101)
M11	-2380.7 (-6.047)	-2305.3 (-6.004)	-2463.1 (-6.697)	-2166.7 (-5.954)
M12	2067.8 (5.611)	2108.3 (5.905)	2267.9 (6.564)	2284.0 (6.725)
M13	-1665.8 (-4.588)	-1544.3 (-4.276)	-1747.0 (-5.142)	-1212.6 (-3.530)
M14	-3005.2 (-8.349)	-2861.9 (-7.821)	-3169.1 (-9.335)	-2496.6 (-7.157)
M15	-2809.9 (-7.877)	-2675.2 (-7.452)	-2941.4 (-8.771)	-2343.7 (-6.857)
M16	825.46 (2.273)	872.45 (2.491)	956.09 (2.832)	986.39 (2.971)
M17	-1154.3 (-3.274)	-1060.4 (-3.092)	-1180.2 (-3.593)	-955.77 (-2.941)
M18	-676.00 (-1.948)	-607.54 (-1.811)	-666.00 (-2.064)	-531.92 (-1.673)
M19	-2181.7 (-6.121)	-2077.8 (-5.924)	-2261.9 (-6.784)	-1917.9 (-5.767)
M20	-1815.6 (-4.946)	-1739.5 (-4.877)	-1854.6 (-5.420)	-1652.2 (-4.889)
M21	-2503.4 (-6.012)	-2344.1 (-5.677)	-2623.0 (-6.717)	-2146.2 (-5.476)
M22	-2287.1 (-5.524)	-2135.2 (-5.234)	-2374.6 (-6.129)	-1965.9 (-5.081)
T1 (P)			.01883 (3.418)	-.00045 (-.4216)
T2 (P)			-.57023 (-7.648)	-.12714 (-10.79)
T3 (P)			-.01498 (-1.469)	-.05534 (-3.863)

Table 5.--Continued.

Variable	Model 2i	Model 2j	Model 2k	Model 2l
θ_o	579.51 (3.950)	-2621.3 (-7.097)	441.40 (2.126)	-3097.8 (-7.851)
β_o	.58186 (25.22)	.65667 (27.77)	.57611 (25.24)	.66108 (28.37)
D1(P)	-.21250 (-50.95)	-.22119 (-54.22)	-.21021 (-50.55)	-.22075 (-54.46)
SF(P)	-.01020 (-3.254)	-.01227 (-4.086)	-.01017 (-3.286)	-.01242 (-4.221)
GFI(P)	.00580 (14.71)	.00593 (15.70)	.00580 (14.91)	.00592 (15.98)
T1		1395.6 (3.435)		1609.4 (4.018)
T2		4576.9 (11.14)		4892.5 (12.02)
T3		4260.0 (10.45)		4709.4 (11.60)
M1			516.84 (2.297)	323.51 (1.506)
M2			1346.6 (5.958)	1475.4 (6.865)
M3			231.66 (1.134)	389.48 (2.002)
M4			81.666 (.3892)	-34.348 (-.1722)
M5			129.97 (.6106)	8.2125 (.0405)
T1(P)	.03170 (5.140)	-.00302 (-.2633)	.03107 (5.104)	-.00912 (-.8082)
T2(P)	-.02098 (-2.569)	-.13232 (-10.47)	-.02331 (-2.889)	-.01422 (-11.40)
T3(P)	.07004 (6.637)	-.04501 (-2.960)	.06288 (6.004)	-.06454 (-4.285)

Variable	Model 2m	Model 2n	Model 2	Model 2p
θ_o	3152.2 (17.16)	1850.5 (5.266)	3013.2 (16.07)	583.70 (1.362)
β_o	.48553 (28.53)	.47341 (26.95)	.50658 (22.36)	.55971 (23.09)
D1(P)	-.19682 (-47.89)	-.20088 (-48.37)	-.19387 (-49.79)	-.20100 (-49.55)
SF(P)	-.00966 (-3.200)	-.01041 (-3.583)	-.01038 (-3.681)	-.01150 (-4.136)
GFI(P)	.00690 (28.13)	.00753 (24.60)	.00657 (18.18)	.00652 (18.37)
T1		986.71 (4.911)		1132.3 (2.915)

Table 5.--Continued.

Variable	Model 2m	Model 2n	Model 2o	Model 2p
T2		-230.74 (-.8864)		3172.2 (7.762)
T3		1624.0 (5.448)		2287.8 (5.372)
T1(P)			.01083 (1.902)	-.01342 (-1.223)
T2(P)			-.05165 (-6.745)	-.12394 (-10.16)
T3(P)			.01778 (1.760)	-.03117 (-2.105)
M1(P)	-.03386 (-1.992)	-.02802 (-1.709)	-.01402 (-.8787)	-.00737 (-.4681)
M2(P)	.01879 (1.907)	.01606 (1.686)	.02205 (2.386)	.02110 (2.301)
M3(P)	.05381 (5.516)	.05091 (5.399)	.05338 (5.806)	.05469 (2.301)
M4(P)	.02408 (2.449)	.02335 (2.464)	.0283 (3.078)	.02878 (3.168)
M5(P)	.03023 (-2.821)	-.02909 (-2.823)	-.03022 (-3.019)	-.02584 (-2.615)
M6(P)	-.03442 (-2.903)	-.03590 (-3.131)	-.03250 (-2.893)	-.02738 (-2.466)
M7(P)	.00812 (.8032)	.00725 (.7439)	.01309 (1.383)	.01322 (1.414)
M8(P)	.02331 (2.282)	.02207 (2.237)	.02951 (3.077)	.03094 (3.255)
M9(P)	.03701 (3.590)	.03773 (3.807)	.03790 (3.937)	.03997 (4.212)
M10(P)	-.05846 (-4.109)	-.05418 (-3.948)	-.03818 (-2.855)	-.03042 (-2.298)
M11(P)	-.08393 (-6.094)	-.07433 (-5.547)	-.08096 (-6.276)	-.06833 (-5.323)
M12(P)	.03830 (3.785)	.03702 (3.797)	.03953 (4.160)	.42454 (4.530)
M13(P)	-.06578 (-5.064)	-.05102 (-3.948)	-.06134 (-5.033)	-.03803 (-3.051)
M14(P)	-.13700 (-9.467)	-.11557 (-7.812)	-.13221 (-9.693)	-.09752 (-6.797)
M15(P)	-.11750 (-8.900)	-.10074 (-7.592)	-.11339 (-9.136)	-.08684 (-6.775)
M16(P)	.00621 (.6058)	.00722 (.7323)	.01080 (1.126)	.01270 (1.343)
M17(P)	-.02781 (-2.529)	-.02146 (-2.015)	-.02557 (-2.486)	-.01779 (-1.745)
M18(P)	-.01380 (-1.352)	-.01075 (-1.094)	-.01243 (-1.303)	-.00907 (-.9640)
M19(P)	-.08251 (-6.826)	-.07198 (-6.083)	-.79390 (-7.006)	-.06573 (-5.789)

Table 5.--Continued.

Variable	Model 2m	Model 2n	Model 2o	Model 2p
M20(P)	-.06622 (-5.617)	-.05994 (-5.256)	-.06388 (-5.790)	-.05691 (-5.210)
M21(P)	-.10632 (-5.928)	-.08587 (-4.829)	-.10084 (-5.990)	-.07289 (-4.261)
M22(P)	-.08961 (-5.477)	-.07329 (-4.555)	-.08482 (-5.530)	-.06320 (-4.090)
Variable	Model 2q	Model 2r	Model 2s	Model 2t
θ_o	2918.0 (4.059)	2572.9 (766.3)	3645.7 (5.333)	2084.63 (2.710)
β_o	.49151 (19.64)	.46535 (18.49)	.49954 (18.08)	.53059 (18.44)
D1(P)	-.16864 (-38.86)	-.16618 (-35.01)	-.15933 (-35.95)	-.16463 (-35.44)
SF(P)	-.00810 (-2.850)	-.00845 (-3.068)	-.00869 (-3.268)	-.00962 (-3.660)
GFI(P)	.00672 (28.74)	.00712 (24.26)	.00604 (17.80)	.00608 (18.07)
T1		1176.3 (6.091)		518.39 (1.384)
T2		-284.48 (-1.142)		2520.0 (6.350)
T3		851.36 (2.927)		1451.4 (3.483)
M1	6419.0 (4.601)	5451.9 (4.026)	4531.6 (3.447)	3929.8 (3.022)
M2	1766.6 (1.941)	1822.7 (2.066)	2015.0 (2.344)	1964.3 (2.302)
M3	3566.1 (3.678)	3486.9 (3.703)	3676.2 (4.024)	3478.0 (3.846)
M4	3433.2 (3.883)	3350.6 (3.913)	3302.6 (3.976)	3182.9 (3.875)
M5	697.11 (.8173)	600.44 (.7278)	499.81 (.6259)	300.70 (.3809)
M6	8074.0 (7.619)	7798.6 (7.593)	7656.1 (7.701)	7293.2 (7.409)
M7	2157.9 (2.352)	2053.5 (2.310)	2035.3 (2.360)	1931.8 (2.265)
M8	1494.8 (1.582)	1422.6 (1.552)	1407.6 (1.576)	1196.2 (1.349)
M9	-2158.3 (-2.289)	-2061.7 (-2.259)	-1859.5 (-2.104)	-1852.2 (-2.122)
M10	5770.5 (4.862)	5187.0 (4.505)	4555.2 (4.072)	4058.7 (3.664)
M11	-900.70 (-.9899)	-1194.0 (-1.353)	-1451.3 (-1.698)	-1657.5 (-1.963)

Table 5.--Continued.

Variable	Model 2q	Model 2r	Model 2s	Model 2t
M12	4088.2 (4.341)	3924.4 (4.298)	3865.3 (4.371)	3607.5 (4.124)
M13	312.83 (.3074)	-48.187 (-.0485)	-322.04 (-.3467)	-443.08 (-.4673)
M14	-1275.6 (-1.512)	-1508.0 (-1.827)	-1922.9 (-2.415)	-1899.8 (-2.410)
M15	-983.62 (-1.165)	-1210.7 (-1.465)	-1622.5 (-2.036)	-1525.3 (-1.933)
M16	3766.0 (4.301)	3640.7 (4.296)	3561.9 (4.341)	3426.0 (4.226)
M17	-1810.9 (-.0438)	-1891.0 (-2.247)	-2178.5 (-2.678)	-2261.5 (-2.814)
M18	-1658.9 (-1.940)	-1752.1 (-2.106)	-2016.8 (-2.512)	-1893.2 (-2.383)
M19	-184.57 (-.2187)	-375.22 (-.4563)	-725.10 (-.9128)	-841.79 (-1.072)
M20	410.95 (.4737)	218.11 (.2590)	-91.768 (-.1126)	-201.08 (-.2499)
M21	-1565.2 (-1.458)	-1645.9 (-1.576)	-2072.8 (-2.053)	-2768.6 (-2.763)
M22	-1379.2 (-1.282)	-1445.1 (-1.382)	-1860.6 (-1.840)	-2471.8 (-2.466)
T1 (P)			.02107 (3.873)	.01108 (1.039)
T2 (P)			-.04722 (-6.515)	-.10502 (-8.898)
T3 (P)			-.00774 (-.7913)	-.03521 (-2.463)
M1 (P)	-.22319 (-5.254)	-.18455 (-4.475)	-.14538 (-3.827)	-.12234 (-3.080)
M2 (P)	-.02000 (-.8582)	-.01748 (-.7745)	-.01638 (-.7480)	-.01548 (-.7085)
M3 (P)	-.02419 (-.9832)	-.01867 (-.7841)	-.01738 (-.7532)	-.01216 (-.5319)
M4 (P)	-.05492 (-2.315)	-.04973 (-2.167)	-.04426 (-1.989)	-.04072 (-1.847)
M5 (P)	-.05536 (-2.183)	-.05200 (-2.119)	-.04979 (-2.096)	-.04131 (-1.756)
M6 (P)	-.22408 (-8.001)	-.21166 (-7.808)	-.20089 (-7.641)	-.18905 (-7.246)
M7 (P)	-.02452 (-1.748)	-.03665 (-1.557)	-.03128 (-1.370)	-.02830 (-1.251)
M8 (P)	-.11567 (-.4699)	-.00575 (-.2414)	.00089 (.0384)	.00698 (.3019)
M9 (P)	.09506 (3.587)	.09379 (3.658)	.08845 (3.563)	.08559 (3.649)
M10 (P)	-.19711 (-6.314)	-.17433 (-5.760)	-.14573 (-4.947)	-.12706 (-4.338)

Table 5.--Continued.

Variable	Model 2q	Model 2r	Model 2s	Model 2t
M11(P)	-.04538 (-1.471)	-.03406 (-1.137)	-.02920 (-1.009)	-.01317 (-.4583)
M12(P)	-.06321 (-2.480)	-.05629 (-2.281)	-.05073 (-2.122)	-.04244 (-1.792)
M13(P)	-.06700 (-1.751)	-.05165 (-1.386)	-.04642 (-1.291)	-.02615 (-.7330)
M14(P)	-.06130 (-1.900)	-.05091 (-1.622)	-.04233 (-1.396)	-.02037 (-.6760)
M15(P)	-.06356 (-2.108)	-.05384 (-1.837)	-.04434 (-1.563)	-.30990 (-1.101)
M16(P)	-.09101 (-3.707)	-.08548 (-3.598)	-.08092 (3.516)	-.07584 (-3.331)
M17(P)	.03709 (1.385)	.40468 (1.558)	.04749 (1.889)	.05536 (2.230)
M18(P)	.03818 (1.531)	.42047 (1.735)	.04949 (2.112)	.04842 (2.092)
M19(P)	-.06884 (-2.471)	-.06139 (-2.267)	-.05302 (-.0424)	-.03954 (-1.527)
M20(P)	-.07479 (-2.740)	-.06763 (-2.554)	-.05946 (-2.319)	-.05115 (-2.019)
M21(P)	-.01569 (-.3357)	-.01241 (-.2711)	-.00281 (-.0640)	.04940 (1.120)
M22(P)	-.01640 (-.3810)	-.01430 (-.3202)	-.00351 (-.0869)	.03732 (.9254)

Variable	Model 2u	Model 2v	Model 2w	Model 2x
θ_o	1010.8 (6.701)	-1626.0 (-6.227)	-48.439 (-.1151)	-2381.2 (-5.230)
β_o	.62201 (43.88)	.52484 (32.15)	.65626 (33.21)	.55246 (26.64)
D1(P)	-.21494 (-49.56)	-.22368 (-53.62)	-.21234 (-48.38)	-.22229 (-52.30)
SF(P)	-.00968 (-2.937)	-.01142 (-3.691)	-.00941 (-2.860)	-.01129 (-3.650)
GFI(P)	.00486 (23.95)	.00770 (24.55)	.00489 (23.95)	.00767 (24.37)
T1		1895.7 (9.274)		1881.4 (9.170)
T2		1300.8 (5.168)		1282.5 (5.052)
T3		3701.5 (13.48)		3669.1 (13.19)
M1			1409.8 (2.679)	623.43 (1.251)
M2			1424.0 (2.624)	1095.5 (2.144)

Table 5.--Continued.

Variable	Model 2u	Model 2v	Model 2w	Model 2x
M3			759.04 (1.601)	789.59 (1.767)
M4			1881.5 (3.660)	1347.10 (2.782)
M5			1055.8 (2.125)	665.23 (1.422)
M1 (P)	.01222 (1.503)	.00552 (.0722)	-.03237 (-1.801)	-.01746 (-1.030)
M2 (P)	.04051 (4.957)	.03495 (4.547)	-.00468 (-.2537)	.00056 (.0323)
M3 (P)	.00558 (.6954)	.00413 (.5478)	-.02209 (-1.259)	-.02284 (-1.382)
M4 (P)	-.00336 (-.4192)	-.00863 (-1.146)	-.02685 (-3.426)	-.051295 (-2.974)
M5 (P)	.00113 (.1407)	-.00429 (-.5684)	-.03500 (-1.980)	-.02798 (-1.683)

Variable	Model 2y	Model 2z	Model 2aa	Model 2bb
θ_o	764.49 (5.142)	-2769.0 (-7.599)	28.491 (.0722)	-3678.7 (-7.275)
β_o	.56783 (23.77)	.65365 (27.02)	.59339 (21.91)	.68494 (25.27)
D1 (P)	-.21213 (-51.48)	-.22217 (-55.38)	-.20995 (-50.23)	-.22091 (-53.95)
SF (P)	-.01044 (-3.381)	-.01263 (-4.298)	-.01025 (-3.328)	-.01249 (-4.257)
GFI (P)	.00585 (15.05)	.00596 (16.12)	.00584 (15.05)	.00594 (16.07)
T1		1669.4 (4.177)		1718.7 (4.278)
T2		4866.1 (12.04)		4935.0 (12.11)
T3		4698.1 (11.68)		4702.8 (11.52)
M1			787.80 (1.582)	667.84 (1.407)
M2			1119.9 (2.200)	1313.5 (2.708)
M3			462.75 (1.041)	1013.5 (2.388)
M4			1689.4 (3.510)	1348.8 (2.936)
M5			620.81 (1.330)	623.74 (1.403)
M1 (P)	.01351 (1.772)	.00848 (1.165)	-.01292 (-.7634)	-.01656 (-1.026)

Table 5.--Continued.

Variable	Model 2y	Model 2z	Model 2aa	Model 2bb
M2 (P)	.03613 (4.697)	.03878 (5.300)	-.00161 (-.0931)	-.00200 (-.1212)
M3 (P)	.00709 (.9430)	.00798 (1.115)	-.01029 (-.6255)	-.02589 (-1.649)
M4 (P)	-.00571 (-.7603)	-.00785 (-1.099)	-.05785 (-3.369)	-.05126 (-3.132)
M5 (P)	.00245 (.3254)	-.00154 (-.2146)	-.01974 (-1.190)	-.02499 (-1.581)
T1 (P)	.02969 (4.884)	-.01186 (-1.052)	.02911 (4.791)	-.01320 (-1.163)
T2 (P)	-.02462 (-3.055)	-.14299 (-11.49)	-.02553 (-3.173)	-.14472 (-11.59)
T3 (P)	.06246 (5.979)	-.06555 (-4.358)	.06134 (5.876)	-.06501 (-4.303)

Table 6. Model 3 results.

Variable	Model 3a	Model 3b	Model 3c	Model 3d
ϕ_o	-.23379 (-21.60)	-.36859 (-15.06)	-.34830 (-24.86)	-.31315 (-12.72)
S	-.00002 (-.0384)	-.00080 (-1.324)	-.00927 (-7.613)	-.01143 (-7.638)
D1	-.31047 (-41.89)	-.30894 (-44.45)	-.32323 (-45.62)	-.31695 (-46.28)
SF	-.00471 (-1.342)	-.00462 (-1.405)	-.00473 (-1.423)	-.00459 (-1.445)
GFI	.00232 (.2243)	.00488 (11.65)	.00517 (16.79)	.00479 (11.79)
T1		.01991 (2.848)		.00132 (.1225)
T2		-.00739 (-.8140)		-.11571 (-9.120)
T3		.08363 (7.681)		.02162 (1.512)
T1(S)			.00538 (4.968)	.00483 (2.784)
T2(S)			.00554 (4.493)	.01986 (11.20)
T3(S)			.01504 (11.39)	.01205 (7.027)

Variable	Model 3e	Model 3f	Model 3g	Model 3h
ϕ_o	-.29876 (-17.95)	-.37007 (-14.73)	-.38312 (-21.03)	-.32120 (-12.89)
S	.00436 (5.405)	.00227 (2.833)	-.00555 (-4.157)	-.00860 (-5.710)
D1	-.31066 (-43.75)	-.30897 (-46.32)	-.32296 (-47.15)	-.31781 (-48.29)
SF	-.00465 (-1.386)	-.00452 (-1.437)	-.00466 (-1.459)	-.00456 (-1.507)
GFI	.00354 (13.97)	.00502 (12.49)	.00568 (17.58)	.00500 (12.88)
T1		.01122 (1.653)		-.01721 (-1.637)
T2		-.02036 (-2.299)		-.14110 (-11.04)
T3		.06464 (5.889)		-.00581 (-.3970)
M1	-.01446 (-.0772)	-.02682 (-1.519)	-.01099 (-.6146)	.00047 (.0275)
M2	-.00841 (-.6603)	-.01190 (-.9949)	-.00683 (-.5625)	.00008 (.0073)
M3	.03747 (3.031)	.02935 (2.523)	.03915 (3.321)	.04120 (3.656)

Table 6.--Continued.

Variable	Model 3e	Model 3f	Model 3g	Model 3h
M4	.02700 (2.220)	.02432 (2.130)	.02816 (2.429)	.03286 (2.983)
M5	-.01652 (-1.380)	.02301 (-2.045)	-.01466 (-1.284)	-.01306 (-1.199)
M6	-.02025 (-.1375)	-.03607 (-2.541)	-.01606 (-1.121)	-.01091 (-.7826)
M7	-.00174 (-.1375)	-.00527 (-.4430)	-.00044 (-.0369)	.00593 (.5156)
M8	-.00544 (-.4217)	-.00852 (-.7035)	-.00320 (-.2601)	.00501 (.4282)
M9	.01995 (1.636)	.01988 (1.738)	.02064 (1.777)	.02045 (1.860)
M10	-.04634 (-3.319)	-.05705 (-2.540)	-.02460 (-2.447)	-.02939 (-1.757)
M11	-.04234 (-3.246)	-.04157 (-3.396)	-.04168 (-3.355)	-.04408 (-3.741)
M12	.04433 (3.586)	.03621 (3.113)	.04601 (3.903)	.04806 (4.265)
M13	-.013960 (-1.128)	-.00412 (-.3527)	.00860 (.7217)	.00386 (.3407)
M14	-.05692 (-4.761)	-.04847 (-4.297)	-.03621 (-3.146)	-.04021 (-3.681)
M15	-.05611 (-4.693)	-.04766 (-4.225)	-.03541 (-3.076)	-.03941 (-3.607)
M16	.03409 (2.793)	.03132 (2.707)	.03493 (3.003)	.03978 (3.599)
M17	-.02169 (-1.825)	-.01477 (-1.321)	-.01006 (-.8863)	-.01556 (-1.444)
M18	-.02093 (-1.776)	-.01376 (-1.241)	-.00721 (-.6400)	-.01215 (-1.135)
M19	-.03222 (-2.711)	-.02530 (-2.264)	-.02059 (-1.814)	-.02609 (-2.421)
M20	-.02622 (-2.136)	-.02193 (-1.902)	-.02059 (-1.760)	-.02448 (-2.205)
M21	-.04571 (-3.288)	-.03446 (-2.632)	-.02806 (-2.110)	-.03625 (-2.869)
M22	-.00450 (-3.234)	-.03372 (-2.575)	-.02732 (-2.054)	-.03551 (-2.811)
T1(S)			.00505 (4.779)	.00657 (3.916)
T2(S)			.00477 (3.925)	.02153 (12.28)
T3(S)			.01368 (.01368)	.01283 (7.461)

Table 6.--Continued.

Variable	Model 3i	Model 3j	Model 3k	Model 3l
ϕ_o	-.24795 (-19.22)	-.37308 (-15.03)	-.36571 (-23.72)	-.31550 (-12.76)
S	.00020 (-.3050)	-.00069 (-1.125)	-.01001 (-8.219)	-.12624 (-8.477)
D1	-.31271 (-42.60)	-.31112 (-45.18)	-.32688 (-46.73)	-.32127 (-47.52)
SF	-.00467 (-1.346)	-.00459 (-1.411)	-.00469 (-1.432)	-.00455 (-1.459)
GFI	.00239 (11.33)	.00486 (11.72)	.00537 (17.61)	.00472 (11.83)
T1		.01935 (2.799)		-.00282 (-.2658)
T2		-.00800 (-.8903)		-.12358 (-9.859)
T3		.08187 (7.583)		.00781 (.5514)
M1	.00612 (.8134)	-.00041 (-.0577)	-.00040 (-.0566)	.00458 (.6732)
M2	.04183 (5.622)	.03516 (5.034)	.04303 (6.124)	.04530 (6.702)
M3	.00842 (1.226)	.00526 (.8182)	.01056 (1.628)	.01453 (2.338)
M4	.00321 (.4573)	-.00167 (-.2536)	.00282 (.4249)	.00420 (.6615)
M5	.00343 (.4817)	.00006 (.0089)	.00006 (.0095)	.00351 (.5474)
T1(S)			.00595 (5.563)	.00563 (3.288)
T2(S)			.00645 (5.274)	.02129 (12.11)
T3(S)			.01602 (12.23)	.01406 (8.235)

Variable	Model 3m	Model 3n	Model 3o	Model 3p
ϕ_o	-.31434 (-24.48)	-.37702 (-15.95)	-.38424 (-26.18)	-.31970 (-13.44)
S	.00353 (2.578)	.00292 (1.751)	-.00627 (-3.046)	-.00857 (-4.016)
D1	-.29584 (-40.96)	-.29865 (-43.41)	-.31257 (-44.14)	-.30639 (-45.24)
SF	-.00486 (-1.451)	-.00472 (-1.490)	-.00485 (-1.510)	-.00471 (-1.437)
GFI	.00355 (15.26)	.00487 (11.65)	.00558 (18.23)	.00475 (12.19)
T1		.01423 (2.102)		-.00551 (-.5306)

Table 6.--Continued.

Variable	Model 3m	Model 3n	Model 3o	Model 3p
T2		-.01976 (-2.219)		-.13248 (-10.67)
T3		.06100 (5.560)		-.00115 (-.0810)
M1 (S)	.00672 (-.6146)	-.00037 (-.0835)	.00361 (.8070)	.00269 (.6256)
M2 (S)	.00207 (.9991)	-.00099 (-.4579)	-.00026 (-.1216)	-.00014 (-.0655)
M3 (S)	.01011 (4.913)	.00674 (3.143)	.00773 (3.565)	.00758 (3.671)
M4 (S)	.00901 (4.884)	.00642 (3.267)	.00688 (3.457)	.00689 (3.645)
M5 (S)	.00173 (.9395)	-.00109 (-.5561)	-.00041 (-.2075)	-.00056 (-.2982)
M6 (S)	.00939 (2.735)	.00299 (.8814)	.00647 (1.901)	.00589 (1.792)
M7 (S)	.00380 (1.840)	.00075 (.3470)	.00144 (.6632)	.00154 (.7467)
M8 (S)	.00260 (1.254)	-.00043 (-.1981)	.00031 (.1432)	.00049 (.2380)
M9 (S)	.00302 (1.767)	.00113 (.6123)	.00121 (.6460)	.00113 (.6336)
M10 (S)	.00188 (.4110)	-.00512 (-1.155)	-.00120 (-.2697)	-.00196 (-.4566)
M11 (S)	-.00336 (-1.885)	-.00501 (-2.610)	-.00503 (-2.585)	-.00521 (-2.824)
M12 (S)	.01287 (6.257)	.00950 (4.432)	.01049 (4.840)	.01034 (5.009)
M13 (S)	.00111 (.7519)	.00070 (.41518)	.00249 (1.448)	.00197 (1.204)
M14 (S)	-.00384 (-2.661)	-.00436 (-2.622)	-.00248 (-1.463)	-.00291 (-1.806)
M15 (S)	-.00381 (-2.637)	-.00432 (-2.601)	-.00245 (-1.443)	-.00288 (-1.785)
M16 (S)	.01247 (6.667)	.00974 (4.907)	.01021 (5.081)	.01026 (5.373)
M17 (S)	-.00186 (-.7941)	-.00178 (-1.051)	-.00098 (-.5724)	-.00178 (-1.088)
M18 (S)	-.00103 (-.7051)	-.00163 (-.9706)	-.00053 (-.3120)	-.00119 (-.7345)
M19 (S)	-.00095 (-.6392)	-.00155 (-.9144)	-.00075 (-.4378)	-.00154 (-.9460)
M20 (S)	-.00004 (-.0265)	-.00107 (-.6085)	-.00082 (-.4585)	-.00134 (-.7883)
M21 (S)	-.00295 (-1.773)	-.00313 (-1.705)	-.00231 (-1.241)	-.00340 (-1.918)
M22 (S)	-.00000 (-1.482)	-.00304 (-1.655)	-.00222 (-1.192)	-.00331 (-1.867)

Table 6.--Continued.

Variable	Model 3m	Model 3n	Model 3o	Model 3p
T1(S)			.00537 (5.076)	.00516 (3.078)
T2(S)			.00516 (4.217)	.02074 (11.94)
T3(S)			.01365 (10.24)	.01216 (7.105)

Variable	Model 3q	Model 3r	Model 3s	Model 3t
ϕ_o	-.25364 (-10.29)	-.32320 (-10.82)	-.32640 (-12.90)	-.29020 (-9.867)
S	-.00062 (-.1843)	-.00430 (-1.335)	-.01164 (-3.410)	-.01283 (-3.821)
D1	-.28579 (-38.82)	-.29400 (-41.92)	-.30773 (-42.34)	-.30801 (-43.57)
SF	-.00449 (-1.391)	-.00447 (-1.465)	-.00455 (-1.471)	-.00457 (-1.553)
GFI	.00307 (12.22)	.00471 (11.96)	.00518 (16.00)	.00478 (12.53)
T1		.01255 (1.895)		-.01484 (-1.420)
T2		-.01613 (-1.842)		-.13071 (-10.23)
T3		.06414 (5.998)		-.00182 (-.1258)
M1	-.18220 (-4.142)	-.14626 (-3.509)	-.15705 (-3.718)	-.07073 (-1.738)
M2	-.04668 (-1.757)	-.04118 (-1.639)	-.03917 (-1.538)	-.01122 (-.4598)
M3	.00172 (.0685)	-.00674 (-.2833)	.00783 (.3251)	.02164 (.9354)
M4	-.03513 (-1.388)	-.03421 (-1.429)	-.03109 (-1.280)	-.01001 (-.4311)
M5	-.07306 (-2.974)	-.08264 (-3.552)	-.06756 (-2.866)	-.05505 (-2.432)
M6	-.19813 (-6.476)	-.20174 (-6.951)	-.17991 (-6.117)	-.14760 (-5.183)
M7	-.04945 (-1.877)	-.04473 (-1.796)	-.04333 (-1.715)	-.01721 (-.7118)
M8	-.04364 (-1.597)	-.03532 (-1.366)	-.03298 (-1.257)	.00046 (.0185)
M9	.06844 (2.623)	.06593 (2.674)	.06793 (2.716)	.07075 (2.969)
M10	-.25099 (-6.247)	-.21802 (-5.727)	-.22861 (-5.926)	-.14757 (-3.968)
M11	-.04820 (-1.689)	-.05362 (-1.986)	-.05062 (-1.851)	-.05652 (-2.165)

Table 6.--Continued.

Variable	Model 3q	Model 3r	Model 3s	Model 3t
M12	-.01365 (-.5437)	-.02211 (-.9297)	-.00754 (-.3128)	.00627 (.2710)
M13	-.04540 (-1.452)	-.06682 (-2.253)	-.05983 (-1.991)	-.05806 (-2.025)
M14	-.06985 (-2.485)	-.08806 (-3.306)	-.08919 (-3.305)	-.08918 (-3.461)
M15	-.06516 (-2.318)	-.08337 (-3.129)	-.08450 (-3.131)	-.08449 (-3.279)
M16	-.07011 (-2.764)	-.06851 (-2.856)	-.06549 (-2.692)	-.04447 (-1.912)
M17	.01817 (.6732)	.00182 (.0711)	.00666 (.2571)	.01071 (.43336)
M18	.02044 (.7620)	.00382 (.1505)	.00697 (.2708)	.01039 (.4231)
M19	-.06692 (-2.480)	-.08327 (-3.259)	-.07843 (-3.028)	-.07438 (-3.010)
M20	-.06983 (-2.538)	-.07988 (-3.070)	-.07439 (-2.821)	-.07642 (-3.036)
M21	-.02450 (-.6460)	-.04945 (-1.376)	-.02560 (-.7023)	-.01955 (-.5613)
M22	-.02447 (-.6452)	-.04942 (-1.376)	-.02557 (-.7014)	-.01952 (-.5604)
M1 (S)	.04569 (4.105)	.03071 (2.909)	.03829 (3.585)	.01711 (1.666)
M2 (S)	.00686 (1.457)	.00460 (1.033)	.00521 (1.154)	.00091 (.2114)
M3 (S)	.00612 (1.357)	.00598 (1.403)	.00462 (1.069)	.00253 (.6100)
M4 (S)	.01195 (2.779)	.01104 (2.716)	.01113 (2.701)	.00799 (2.030)
M5 (S)	.01089 (2.588)	.01147 (2.882)	.00982 (2.433)	.00790 (2.049)
M6 (S)	.05121 (7.216)	.04693 (6.991)	.04591 (6.739)	.03886 (5.960)
M7 (S)	.00910 (1.944)	.00695 (1.571)	.00765 (1.705)	.00362 (.8454)
M8 (S)	.00685 (1.423)	.00415 (.9115)	.00471 (1.021)	-.00045 (-.1016)
M9 (S)	-.00848 (-2.021)	-.00807 (-2.033)	-.00830 (-2.063)	-.00887 (-2.314)
M10 (S)	.05905 (5.728)	.04477 (4.579)	.05230 (5.288)	.03237 (3.402)
M11 (S)	.00171 (.3864)	.00279 (.6653)	.00228 (.5357)	.00266 (.6556)
M12 (S)	.01168 (2.589)	.01154 (2.708)	.01018 (2.355)	.00808 (1.956)
M13 (S)	.00595 (1.401)	.01002 (2.480)	.01062 (2.591)	.00920 (2.355)

Table 6.--Continued.

Variable	Model 3q	Model 3r	Model 3s	Model 3t
M14 (S)	.00367 (.9182)	.00729 (1.920)	.00885 (2.297)	.00776 (2.111)
M15 (S)	.00319 (.7988)	.00681 (1.794)	.00838 (2.173)	.00728 (1.981)
M16 (S)	.02112 (4.873)	.01995 (4.870)	.02008 (4.832)	.01695 (4.276)
M17 (S)	-.00396 (-.9888)	-.00051 (-.1341)	-.00056 (-.1444)	-.00230 (-.6269)
M18 (S)	-.00390 (-.9860)	-.00044 (-.1171)	-.00002 (-.0063)	-.00161 (-.4442)
M19 (S)	.00633 (1.582)	.00978 (2.578)	.00973 (2.530)	.00799 (2.177)
M20 (S)	.00765 (1.849)	.00995 (2.542)	.00933 (2.352)	.00871 (2.301)
M21 (S)	-.00055 (-.1100)	.00421 (.8938)	.00205 (.4280)	-.00027 (-.0595)
M22 (S)	-.00046 (-.0925)	.00430 (.9124)	.00213 (.4463)	-.00018 (-.0404)
T1 (S)			.00463 (4.500)	.00617 (3.708)
T2 (S)			.00441 (3.705)	.02033 (11.50)
T3 (S)			.01280 (9.830)	.01225 (7.050)

Variable	Model 3u	Model 3v	Model 3w	Model 3x
ϕ_o	-.23365 (-21.24)	-.36665 (-15.11)	-.35148 (-25.33)	-.30189 (-12.41)
S	-.00180 (-1.961)	-.00208 (-2.413)	-.01211 (-8.637)	-.01497 (-9.052)
D1	-.31042 (-42.15)	-.30963 (-44.85)	-.32552 (-46.37)	-.31977 (-47.19)
SF	-.00471 (-1.352)	-.00463 (-1.420)	-.00475 (-1.449)	-.00461 (-1.475)
GFI	.00231 (10.92)	.00485 (11.67)	.00529 (17.38)	.00469 (11.74)
T1		.01993 (2.877)		-.00106 (-.1001)
T2		-.00673 (-.7473)		-.12265 (-9.767)
T3		.08413 (7.771)		.01072 (.7569)
M1 (S)	.00114 (1.037)	-.00051 (-.4900)	-.00068 (-.6557)	-.00011 (-.1147)
M2 (S)	.00606 (5.949)	.00522 (5.469)	.00631 (6.559)	.00667 (7.221)

Table 6.--Continued.

Variable	Model 3u	Model 3v	Model 3w	Model 3x
M3(S)	.00151 (1.689)	.00097 (1.160)	.00206 (2.430)	.00253 (3.112)
M4(S)	.00119 (1.271)	.00065 (.7427)	.00110 (1.243)	.00126 (1.492)
M5(S)	.00155 (1.617)	.00086 (.9531)	.00086 (.9493)	.00116 (1.339)
T1(S)			.00594 (5.527)	.00546 (3.181)
T2(S)			.00661 (5.354)	.02146 (12.13)
T3(S)			.01627 (12.29)	.01410 (8.200)

Variable	Model 3y	Model 3z	Model 3aa	Model 3bb
ϕ_o	-.20924 (-10.44)	-.34428 (-12.13)	-.32846 (-15.70)	-.27952 (-9.952)
S	-.00488 (-2.396)	-.00468 (-2.451)	-.01507 (-6.783)	-.01761 (-7.616)
D1	-.31141 (-42.23)	-.31031 (-44.89)	-.32686 (-46.48)	-.32114 (-47.21)
SF	-.00465 (-1.342)	-.00460 (-1.419)	-.00472 (-1.447)	-.00460 (-1.477)
GFI	.00235 (10.93)	.00485 (11.70)	.00532 (17.42)	.00469 (11.77)
T1		.01958 (2.837)		-.00213 (-.2014)
T2		-.00720 (-.8019)		-.12317 (-9.824)
T3		.08347 (7.720)		.00860 (.6045)
M1	-.02933 (-1.600)	-.01478 (-.8598)	-.01787 (-1.034)	-.01102 (-.6678)
M2	.00476 (.2603)	.00253 (.1477)	.00491 (.0285)	.00500 (.3035)
M3	-.02214 (-1.247)	-.01711 (-1.028)	-.02885 (-1.722)	-.02485 (-1.554)
M4	-.03921 (-2.202)	-.04211 (-2.523)	-.03776 (-2.251)	-.03683 (-2.296)
M5	-.05022 (-2.790)	-.04168 (-2.472)	-.04646 (-2.740)	-.03968 (-2.451)
T1(S)			.00600 (5.595)	.00560 (3.270)
T2(S)			.00665 (5.394)	.02148 (12.15)
T3(S)			.01631 (12.32)	.01432 (8.287)

Table 6.--Continued.

Variable	Model 3y	Model 3z	Model 3aa	Model 3bb
M1 (S)	.00476 (1.839)	.00101 (.4159)	.00122 (.4995)	.00085 (.3662)
M2 (S)	.00508 (2.075)	.00459 (2.000)	.00533 (2.309)	.00573 (2.598)
M3 (S)	.00412 (1.791)	.00298 (1.384)	.00549 (2.522)	.00549 (2.640)
M4 (S)	.00597 (2.551)	.00584 (2.665)	.00571 (2.587)	.00578 (2.746)
M5 (S)	.00788 (3.291)	.00610 (2.720)	.00671 (2.971)	.00615 (2.854)