UCD

82-3

UCD Department of Agricultural Economics

[redacted]

WORKING PAPER SERIES

University of California, Davis
Department of Agricultural Economics

ORCHARD INVESTMENT AND THE ECONOMIC RECOVERY TAX ACT OF 1981

by

Sermin D. Hardesty and Hoy F. Carman

Working Paper No. 82-3

University of California, Davis
Department of Agricultural Economics

ORCHARD INVESTMENT AND THE ECONOMIC RECOVERY TAX ACT OF 1981

by

Sermin D. Hardesty and Hoy F. Carman

ORCHARD INVESTMENT AND THE ECONOMIC RECOVERY TAX ACT OF 1981

Federal tax policy has often been used to achieve economic objectives. The Economic Recovery Tax Act of 1981 (ERTA) is a recent example of legislation designed to affect investment decisions. Its goal is to encourage capital formation in the private sector through accelerated recovery of capital expenditures, revised investment tax credits, and tax rate reductions. ERTA reduces tax rates and increases after-tax rates of return in the short-run from both agricultural and nonagricultural investments. Its long-run implications are unclear.

The Accelerated Cost Recovery System (ACRS) established by ERTA substantially revises depreciation rules for capital assets. This article outlines the nature of the impacts of ACRS on orchard, grove and vineyard investments. A capitalized income model is used to demonstrate the effect of tax rules on the price of depreciable assets. The initial impact of ACRS on relative asset prices is demonstrated through a numerical example. Then a change in grove prices is incorporated in a supply reponse model and the model is used to illustrate the possible impacts through time of ACRS on California navel orange acreage, production and prices. The theoretical development and numerical examples assume 100% equity financing of investments.

Capitalized Income Model

Tax depreciation rules affect the present value of after-tax income generated by depreciable assets. A capitalized income model demonstrates the manner in which tax provisions affect absolute and relative prices of capital assets. The equilibrium condition that nominal after-tax rates of return must be equal for all assets of equal risk is fundamental to this approach.

Assume that income is taxed at a marginal rate t and that all assets are required to yield the same normal after-tax rate of return r. Let p be the expected rate of inflation. Economic depreciation occurs as the income producing capacity of an asset decreases. The rate of economic depreciation for each type of asset (δ_i) is assumed to be constant over time but the rate differs according to the durability of the asset. Thus, the income (I) generated by the i^{th} asset during the n^{th} period is equal to:

(1) $$I_{in} = I_{i0}(1-\delta_i)^n(1+p)^n$$

where I_{i0} represents the initial level of income. Note that the income flow generated by the asset decreases through time. Annual depreciation per dollar of investment in a capital asset for tax purposes is expressed as d. If Z_i is the present value of the tax depreciation deduction allowed per dollar of acquisition cost for the i^{th} asset, it can be expressed as:

(2) $$Z_i = \sum_{n=1}^{Q} \frac{d_{in}}{(1+r)^n}$$

where Q is the tax life of the asset.

Traditional capital asset pricing theory requires that the price of a capital asset be equal to the present value of the after-tax flow of income generated by the asset. In the absence of taxes, the price (P) of the i^{th} asset is:

(3) $$P_i = \sum_{n=1}^{N} \frac{I_{i0}(1-\delta i)^n(1+p)^n}{(1+r)^n}$$

where N is the economic life of the asset. When taxes are imposed and depreciation deductions and investment credits (at a rate of K per dollar of asset cost) are allowed, the pricing relationship becomes:

(4) $$P_i(T) = \sum_{n=1}^{N} \frac{I_{i0}(1-\delta i)^n(1+p)^n(1-t)}{(1+r)^n} + P_i(T)tZ_i + P_i(T)K_i$$

The presence of taxation does not change the before-tax income flow generated by the asset. Substituting equation (3) for the first term of equation (4) yields:

$$P_i(T) = P_i(1-t) + P_i(T)tZ_i + P_i(T)K_i \quad (5)$$

which is equivalent to :

$$P_i(T) = \frac{P_i(1-t)}{1-tZ_i-K_i} \quad (6)$$

With taxes, the price of the asset $P_i(T)$ decreases as the tax rate t increases and increases as the present value of the depreciation deductions and/or investment credit rate increases. With taxes, the relative prices of any two depreciable assets can be expressed as:

$$\frac{P_i(T)}{P_j(T)} = \frac{P_i\ (1-tZ_j-K_j)}{P_j(1-tZ_i-K_i)} \quad (7)$$

This ratio will be equal to the ratio of asset prices without taxes (P_i/P_j) only if $tZ_j + K_j$ is equal to $tZ_i + K_i$. Thus, tax rules can alter both absolute and relative prices of depreciable assets. These results provide the theoretical framework for analyzing the immediate impact of ACRS on the market value of capital assets.

The Accelerated Cost Recovery System (ACRS)

Traditional depreciation of assets has been replaced by ACRS for assets placed in service after 1980. ACRS permits more rapid recovery of capital costs and involves substantial simplification of depreciation rules. A five class system of cost recovery is provided with most agricultural assets fitting into three of the classes, 3-year, 5-year, and 15-year. The taxpayer determines the appropriate class for depreciable property and then applies a statutory percentage to the unadjusted basis of the property. The total cost of the asset is recovered; thus, salvage value is not required and does not enter the calculations.

The impact of ACRS on tree and vine crops is dramatic. Under previous rules, most trees and vines were depreciated over a bearing life which may have ranged from 15 to 50 years. Now trees and vines are classed as 5-year assets, and their total cost can be recovered over a 5-year period.

The statutory percentage write-offs for 5-year property for three time periods are shown in Table 1. The first year percentage is applicable regardless of when during the year the asset is placed in service. This provides opportunities for year-end tax motivated purchase of depreciable assets. After 1985, the ACRS percentage write-offs in Table 1 are equivalent to sum-of-the-years digits depreciation with the property being treated as if it were purchased in the middle of the year.

Table 2 presents data on useful lives for various California orchards and vineyards and recent estimates of the value per acre of trees or vines, the depreciable asset. The market values were affected by the tax rules in effect at the time. A 10% investment credit was provided under previous tax rules.[1] The 150% declining balance method was the most accelerated depreciation rule which could be used for an orchard purchased when it was already bearing commercially. The present values of depreciation deductions per dollar of investment using the 150% declining balance method can be calculated using equation (2). It is:

$$Z_{i},(DB) = \sum_{n=1}^{Q} \frac{1.5}{Q} \left(1 - \frac{1.5}{Q}\right)^{n-1} \frac{1}{(1-r)^{n}} \tag{8}$$

As shown, the present value of depreciation deductions is an inverse function of the tax life, other factors being equal. Assuming that all orchard owners were in the same marginal income tax bracket and used the 150% declining balance depreciation method, equation (7) requires that the relative prices of orchards under the previous tax rules differ from what they would have been if no depreciation deductions had been allowed.

Using the rates shown in Table 1, the present value of ACRS deductions per dollar of asset cost for a 5-year class asset purchased between 1981 and 1984 is:

$$(9) \qquad Z_1(AC) = \frac{.15}{1+r} + \frac{.22}{(1+r)^2} + \sum_{n=3}^{5} \frac{.21}{(1+r)^n}$$

This value is the same for all assets in the 5-year class. Using equation (7), it can be concluded that ACRS will cause orchard prices to change such that their relative prices will no longer differ from those existing without taxes.

The relationship between orchard prices under ACRS, P(AC), and under previous tax rules, P(DB), can be calculated using (6), where P is the orchard price in the absence of taxes.

$$(10) \qquad \frac{P(AC)}{P(DB)} = \frac{P(1-t)/1-tZ(AC)-K}{P(1-t)/1-tZ(DB)-K}$$

which gives:

$$(11) \qquad P(AC) = P(DB)\,\frac{(1-tZ(DB)-K)}{(1-tZ(AC)-K)}$$

The investment tax credit K was 10% before and after passage of ERTA. Since Z(AC) will be identical for all orchards, the relationship in equation (11) indicates that ACRS will produce disproportionate changes in orchard prices. The prices of long-lived orchards will increase proportionately more than those with short lives.[2]

The following numerical example demonstrates this effect. As shown in Table 2, the market values of peach and walnut orchards were the same

Table 1. Percentage Write-Offs for 5-Year Property.

Recovery year	Percentage write-off for property placed in service during: 1981-84	1985	after 1985
	------------percent------------		
1	15	18	20
2	22	33	32
3	21	25	24
4	21	16	16
5	21	8	8

Source: Durst, Rome and Hrubovcak (p. 37-38).

Table 2. Typical Useful Lives and Estimated Values of California Perennial Crops, 1981.

Crop	Typical Life (years)[a]	Estimated Market Value ($per acre)[b]
Almonds	30	$4950
Apricots	35	3250
Navel oranges	35	2750
Table grapes	30	5150
Olives	50	1200
Peaches	20	4100
Prunes	30	3250
Walnuts	40	4100

[a]Source: Reed and Horel.

[b]Farm Real Estate Market Developments. The book value is the value of land and trees (or vines) minus the value of bare irrigated land. All values are for the San Joaquin Valley.

before ACRS was passed while their typical lives differed. For purposes of illustration, let t equal .50 and r be 8%. The present value of the depreciation deductions using the 150% declining balance method is .462 and .316, respectively, per dollar of acquisition cost for peach and walnut orchards.[3] The present value of the ACRS deductions is .791 per dollar of acquisition cost. According to (11), the price of peach orchards must increase from $4,100 per acre to $5,437 per acre for a new owner to get the same 8% nominal after-tax rate of return as existing peach orchard owners are assumed to be earning.[4] The new price of a walnut orchard must rise to $6,030 per acre. The walnut orchard price increase due to ACRS is $593 higher per acre because the change from the 150% declining balance method to ACRS produces a greater increase in the present value of after-tax income from walnut orchards with a typical life of 40 years than from peach orchards with a typical life of 20 years. In doing so, ACRS restores the relative prices of orchards to what they would be if income from orchards was not taxed.

Expected Response

The significant increases in present value of tax depreciation from orchard crops can be expected to have both short-and long-run impacts. Capital asset pricing theory demonstrates that prices of established orchards and vineyards will rise in the short-run. The increased price an investor will be willing to bid for an orchard will depend on the investor's tax bracket and discount rate. The value of depreciation deductions increase with the tax bracket of the investor. Likewise, the increase in the value of orchards will vary by crop with the largest increases, *ceteris paribus*, for crops with the longest tax lives prior to ERTA.

Current deduction of orchard crop pre-production development expenses has provided significant tax shelter advantages to both farm and nonfarm investors. Investor interest, however, will probably shift from orchard crop development to purchase of established orchards because of the tax advantages offered by ACRS. Thus, there will likely be a short-run decrease in orchard plantings. Citrus and almonds, which had their tax shelter advantages for development terminated by capitalization provisions effective in 1970 and 1971, will again offer tax shelter advantages as a result of ACRS.

The longer term investor response to ACRS is difficult to forecast because of the many variables and lagged responses involved. After orchard prices increase, there will probably be renewed interest in orchard development. This will lead to increased production and lower product prices several years later. The dynamics of the long-term adjustment process can be illustrated with a model of perennial crop supply response.

A Supply Response Model

A number of perennial crop supply response models have been specified and estimated. These models have been used to project acreage, production and prices for various crops and to estimate the effects of marketing order provisions, variety and planting innovations and tax law changes (Bushnell; Carman; French and Bressler; French and Matthews; Minami, French, and King; Rae and Carman; and Thor). The models each contain similar components but there are differences depending on the objectives of the particular study.

The usual recursive supply response model follows the sequence:

a. Output price is a function of current production and demand factors.

b. Profit expectations are a function of recent output prices and cost conditions.

c. Orchard plantings, removals and total acreage are a function of profit expectations.

d. There is a time lag between orchard planting and production.

e. Production is a function of bearing acreage and yield per acre.

Some model components, such as profit expectations, are unobservable and must be replaced with proxy variables. Most studies assume that producer and investor expectations are based on recent experience. Recent prices or total revenue adjusted for changes in production costs are, thus, used as a proxy for profit expectations.

The initial impact of ERTA on orchard crops is to increase the present value of depreciation which leads to an increase in orchard prices. While previous models have not explicitly considered the price of the orchard asset, it does fit within the established theoretical framework. According to the income capitalization model, the price of an orchard (excluding the land value) is determined by the expected profits over the life of the investment and, further, that expected profits are based on recent experience. Modification of the computational sequence is minor. An expression for orchard price is added and acreage adjustments (planting, removals, and total acreage) are specified as a function of orchard prices. Profit expectations are naive; they are not directly affected by these acreage adjustments until production and prices change.

An example of the long-run effects of ACRS on orchard crops is developed for California navel oranges. The basic supply response model utilized is presented by Carman, but the addition of orchard prices requires re-estimation of the acreage relationship (p. 172-73).

Estimated Model Components

The supply response model for navel oranges includes estimated equations for grove price (GP), annual plantings (PL), annual change in total acreage (COA), and navel orange price (P). The estimated equations, based on data for the period 1962-1980, are shown in Table 3. Other model components include average yield and expressions to calculate bearing acreage and per capita navel orange production.[5] Note that the specification and estimation of the equation for orchard price is in Hardesty and Carman (pp. 56-58).

Projected Impacts

The navel orange supply response model can be used to project adjustments in acreage, production and price both with and without ACRS. Assumptions regarding the marginal tax bracket of the typical navel orange grove buyer and the appropriate discount rate are necessary. The analysis is done using the top marginal tax rate of 50% and an after-tax rate of return of 8%. Navel orange groves have a typical useful life of 35 years (Table 2). The estimated 1981 value of a navel orange grove in California's San Joaquin Valley was \$2,352 per acre without ACRS. Using equation (8), $t=.5$, and $r=.08$ results in an estimated price of \$3,395 per acre with ACRS. Thus, the price of orange groves can increase \$1,043 after ACRS and yield the same after-tax rate of return as before the tax change, ceteris paribus. The intercept of the estimated grove price equation in Table 3 is increased by the deflated value of this increase to incorporate the initial impact of ACRS. No other changes in the parameters of the supply response model equations are required to simulate the long-run effects of ACRS.[6]

Table 3. California Navel Orange Supply Response Model Components

Estimated Equations	Summary Statistics R^2	Durbin-Watson
Grove Price		
$GP_t = 360.88 + 2.26TR_{t-1} - 610.33\ TAX$ (1.28) (7.39) (-4.26)	.96	1.98
Plantings		
$PL_t = -2592.48 + 4.00\ (GP_{t-1} + GP_{t-2})/2$ (-4.41) (12.95)	.93	1.31
Change in Total Acreage		
$COA_t = -6920.01 + 5.28\ (GP_{t-1} + GP_{t-2})/2$ (-8.67) (12.58)	.93	2.77
Farm Price, dollars per box		
$P_t = 4.98 - .05Q_t + .0008\ PDI_t$ (12.11) (-7.19) (8.01)	.81	1.43

Figures in parenthesis are t-statistics.

Variable definitions:

GP_t is navel orange grove price per acre (trees only) deflated by a revised index of prices paid by farmers (1967=1.00).

TR is total revenue per acre deflated by a revised index of prices paid by farmers.

TAX is a dummy variable for tax reform requiring capitalization of citrus grove development costs, 1962-69=0, 1970-80=1.

PL is acreage of new California navel orange grove plantings.

COA is the change in total acreage of California navel orange groves.

P is the farm price of navel oranges, dollars per box.

Q is navel orange production, boxes per 1,000 population.

PDI is per capita disposable income.

The supply response model with and without the ACRS-induced shift in the market price equation is used to project values for the period 1982-1995. The assumed values of the variables for the projections are as follows:

- Population is the series II projection of the entire U.S. population.
- Per capita income and the cost deflator use 1980 values.
- Yield is the average for the years 1962-1979.

The impact of ACRS derived from running the simulation with and without the ACRS-induced shifts in the market price of groves is displayed in Table 4. By the year 1995, ACRS is responsible for a 22% increase in the market price of navel orange groves, a 27% increase in total California navel orange acreage and a 7% decrease in the price of navel oranges. It should be noted that these represent the maximum effects of ACRS. The initial rise in the market value of navel orange orchards will probably occur gradually, rather than immediately as is assumed. Furthermore, the average marginal tax bracket of grove buyers will probably be less than the 50% assumed, resulting in a smaller initial increase in grove prices than calculated above. Thus, the impact of ACRS on acreage, production and price per box will probably be less than shown in Table 4.

A limited test of the impact of investor tax bracket on grove prices and long-run response was made by assuming an investor in the 30% tax bracket with all other variables as before. The initial increase in grove price due to ACRS was $477 per acre. By 1995, ACRS was responsible for a 9% increase in market price of navel orange groves, a 13% increase in total California navel orange acreage and a 3.8% decrease in navel orange prices. These impacts would seem to be at the lower bound of expected results since taxpayers with lower incomes would probably have difficulty financing grove investments.

Table 4. Estimated Percentage Impact of ACRS on California Navel Orange Grove Prices, Total Acreage and Product Price for Investor in 50% Tax Bracket, 1983-1995

Year	Increase in Grove Price	Increase in Total Acreage	Decrease in Product Price
	----------	percent	----------
1983	39	3	.4
1986	35	8	1.2
1989	31	14	2.8
1992	26	20	5.3
1995	22	27	7.3

The decrease in output price occurs because the initial increase in grove price causes an increase in plantings and a decrease in removals, which leads to a subsequent increase in production per capita. As output price decreases, the increase in grove prices induced by ACRS will gradually disappear. Grove prices will eventually decrease below the level that would have existed without ACRS, resulting in decreases in total acreage and production.

Conclusions

Accelerated capital recovery provisions in the Economic Recovery Tax Act of 1981 will have significant and long-lasting impacts on orchard, grove and vineyard investments. Capital cost, formerly recovered over a period of 15 to 50 years, can now be recovered in 5 years. The present value of depreciation deductions are substantially increased. The capital asset pricing model demonstrates that orchard prices will rise to the point where the orchard produces the same after-tax rate of return as it did before ACRS. The increased amount that an investor will be willing to bid for an orchard is a function of the required rate of return and the investor's marginal income tax bracket.

The initial increase in the price of established trees and vines will lead to increased acreage and production of perennial crops. Thus, ACRS interrupts and alters the cyclical pattern of supply response for these crops. With the new cyclical pattern, the next peak in acreage and production will occur at a higher level than without ACRS. Decreased prices will result in lower orchard prices, decreased acreage and lower production. As demonstrated, these adjustments occur over many years.

pl 8/30/82 JH5

FOOTNOTES

[1]An investment tax credit of 10% of the acquisition cost of eligible new assets was allowed. Only $100,000 of the value of used property was eligible for the investment tax credit under previous tax rules. Under ERTA, this limit is increased to $125,000 in 1981 and to $150,000 in 1985. When this limit is exceeded, the effective investment credit rate is obviously less than the statutory rate. It will be assumed throughout this analysis that the limit is not binding, in order to avoid needless complications.

[2]It is possible that ACRS could reduce the present value of the tax savings from depreciation deductions (tZ) for some people. The analysis assumes that the taxpayer's marginal tax rate is constant. If his income is rising so rapidly that the growth rate in his marginal tax rate is greater than his discount rate, it may be advantageous for him to spread out his depreciation deductions over a longer term.

[3]These values are valid only if the orchards are purchased when they begin bearing commercially. The illustration becomes complicated if it is assumed that the orchards have been bearing for X years; in such cases, the depreciable life is equal to the typical life less X years and the depreciable basis of the orchard is equal to the market value of the orchard less the depreciation claimed by previous owners of the orchard.

[4]It is assumed that capital is perfectly mobile and that there are perfect markets for capital assets.

[5]Validation of the model with the addition of an expression for grove prices indicated that it performed at least as well as the navel orange model in Carman. The root-mean-square percent errors for the period 1970-80 were: total acreage, .0038; production, .0100; and farm price, .0318.

[6]The lagged adjustments in the depreciation schedule actually require additional shifts in the intercept of the estimated grove price equation. However, the magnitude of these shifts is relatively small.

REFERENCES

Bushnell, Peter G. "Dynamic Analysis of the World Almond Market and the United States Almond Marketing Order." Ph.D. Thesis, University of California, Davis, 1978.

Carman, Hoy F. "Income Tax Reform and California Orchard Development," Western Journal of Agricultural Economics 6(1981):165-180.

Durst, Ron, Wendy Rome, and James Hrubovcak. The Economic Recovery Tax Act of 1981: Provisions of Significance to Agriculture. Washington, D.C.: USDA, ERS, NED, Staff Report No. AGES 810908B, September 1981.

French, Ben C. and Raymond C. Bressler. "The Lemon Cycle." Journal of Farm Ecomonics 44(1962):1021-36.

French, Ben C. and Jim L. Matthews. "A Supply Response Model for Perennial Crop." American Journal of Agricultural Economics 53(1971):478-490.

Hardesty, Sermin D. and Hoy F. Carman. "An Analysis of the Impact of Capitalization Requirements on the Market Value of Citrus Groves." Journal of the American Society of Farm Managers and Rural Appraisers 46(1982) 55-60.

Minami, Dwight D., Ben C. French and Gordon A. King. An Econometric Analysis of Market Control in the California Cling Peach Industry. Giannini Foundation Monograph No. 39, University of California, Berkeley, 1979.

Rae, Alan N. and Hoy F. Carman. "A Model of New Zealand Apple Supply Response to Technological Change." The Australian Journal of Agricultural Economics 19(1975):39-51.

Reed, A. D. and L. A. Horel. Orchard Development Costs. University of California, Division of Agricultural Sciences, Leaflet 2717, Revised October 1977.

Thor, Peter K. "An Economic Analysis of the Marketing Orders for the California-Arizona Orange Industry." Ph.D. Thesis, University of California, Davis, 1980.

U.S. Department of Agriculture. Farm Real Estate Market Developments, Annual issues.