Measuring Implicit Rental Rates for Farm Capital

By James Hrubovcak*

Abstract

Developing implicit rental rates for capital inputs is an important step in understanding the impact of tax law changes on agricultural investments This article develops a methodology for estimating implicit rental rates and presents annual estimates of rental rates for seven categories of farm equipment and structures from 1955 to 1979 This article also compares these rental rates with those estimated under a no-tax alternative The author developed a method for estimating marginal Federal income tax rates for farm sole proprietorships

Keywords

Implicit rental rate, marginal tax rate, investment, depreciation, capital

Introduction

Federal income tax regulations are important determinants of which assets make up the capital stock However, taxes only affect the mix of the capital stock if the effects of tax laws are not neutral toward all assets—that is, if they distort the relative after-tax prices of assets In the absence of other distortions, if tax provisions such as accelerated methods of depreciation, short tax lives, and the investment tax credit lower the after-tax price of some assets more than others, investors are encouraged to purchase more of the affected assets (*5*) [1] Any resulting change in the capital stock may lower economic efficiency as investors are responding to tax factors rather than market factors

One way to analyze the effects of changes in tax laws on the mix of capital inputs is to compare implicit rental rates for various assets Rental rates differ from asset prices in that they measure the cost of a flow of a capital service during a specific period Rental rates are a function of the prices of assets, rates of economic or capacity depreciation, tax variables, the discount rate, and the rate of inflation Rental rates are the cost of capital services that are internally supplied by the firm (*5*) Therefore, as tax variables are changed, so is the cost of supplying capital services and the demand for those services

This article presents annual estimates of the marginal income tax rates of farm sole proprietorships and rental rates for seven categories of farm equipment and structures from 1955 to 1979 in an attempt to improve the current understanding of how Federal income tax policy affects the level of agricultural investment

Estimating Implicit Rental Rates

The implicit rental price of a unit of capital service is the after-tax cost of the capital service that is internally supplied by the firm When the firm is treated as a lessor of capital services, the rental rate is the price the firm will charge for each unit of capital services leased Therefore, the implicit rental rate is the rate the firm must charge to earn a required after-tax rate of return The rental rate is a function of the price of the asset, the rate of capacity depreciation, the tax variables, the discount rate, and the rate of inflation True rental rates are directly observed from market transactions with active rental markets Implicit rental rates are

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[1] Italicized numbers in parentheses refer to items in the References at the end of this article

estimates of the true rental rates that would prevail under given sets of assumptions Nonneutral tax-induced changes in rental rates affect the capital stock as lower taxed capital inputs are substituted for higher taxed capital inputs Assuming perfectly competitive market conditions and cost-minimizing behavior, firms adjust their stocks of capital inputs until the ratio of the marginal products of any pair of inputs equals the ratio of their respective rental rates To the degree that inputs are substitutable, a change in tax law which decreases the rental rate of one input relative to other inputs will increase the demand for the lower priced input until the cost-minimization conditions are satisfied This situation does not imply that the same tax treatment is appropriate for each type of asset In the presence of an otherwise neutral income tax system, inflation can bias the mix of inputs used Because tax depreciation deductions are based on the historical cost of assets, inflation reduces the real value of the nominal deductions, with the reduction being the greatest for shorter lived assets (*8*) During inflation, the use of historical cost tax depreciation for all assets increases demand for long-lived assets relative to assets with shorter lives

A formula for implicit rental rates can be developed from the equality between the purchase price of an asset and the present value of the future rents generated by the asset (*9*) Assuming constant new asset price expectations and allowing for alternative depreciation patterns, the basic Jorgenson equation converted to discrete time is

$$q_i = \sum_{t=1}^{L_i} u_i a_i(t)/(1+r)^t \qquad i = 1,2, \ ,m \qquad (1)$$

where q_i is the purchase price of the ith asset when new, L_i is the service life of the asset, u_i is the rental rate for a new (undepreciated) unit of capital, $a_i(t)$ is the capacity of a unit of capital in year t of its service life, and r is the discount rate The capacity of the asset is 1 in period 1 and declines over its service life as a function of the rate of capacity depreciation

Equation (1) ignores all tax considerations When capital income is subject to an income tax, the term on the right side of equation (1) must be modified and expanded to include the effects of the tax The expanded term included expressions for the present value of the after-tax rents generated by the asset and for the present value of the tax savings produced by the investment tax credit and tax depreciation deductions Assuming the firm's marginal tax rate remains constant as T, equation (1) respecified to accommodate the tax system becomes

$$q_i = (1-T)u_iA_i + C_iq_i + T(1-dc_i)B_iq_i \qquad (2)$$
$$i = 1,2, \ ,m$$

where $(1-T)u_iA_i$ is the present value of the after-tax rents, C_iq_i is the present value of the tax saving produced by the investment tax credit, and $T(1-dc_i)B_iq_i$ is the present value of the tax saving produced by tax depreciation deductions

With constant price expectations and a constant marginal tax rate, the rental rate remains constant over the life of the asset The capacity of the asset, however, declines over the life of the asset so that

$$A_i = \sum_{t=1}^{L_i} a_i(t)/(1+r)^t \qquad i = 1,2, \ ,m \qquad (3)$$

where r is the discount rate which is the real after-tax rate of return required by the firm

Although the firm pays taxes on the rents generated by each asset, the firm is also allowed to deduct the decline in the value of the asset as an expense If the present value of the depreciation deductions claimed for tax purposes is equal to the true decline in market value for each asset, the tax system does not bias investment toward any asset

If $b_i(t)$ is the fraction of the price of the ith asset that is deducted from taxable income in year t of the asset's tax life (M_i), the present value of the tax depreciation is TB_iq_i, where

$$B_i = \sum_{t=1}^{M_i} b_i(t)/(1+r)^t(1+p)^t \qquad i = 1,2, \ ,m \qquad (4)$$

and p is the rate of inflation However, in some years the tax depreciation base was reduced by the amount of the investment tax credit Therefore, a more general expression for the present value of tax depreciation deductions is $T(1-dc_i)B_iq_i$, where d is the percentage of the credit, if any, which must be

used to reduce the tax depreciation base In addition to the depreciation deductions, firms may also be eligible to claim an investment tax credit (c) If firms claim the credit at the end of the first year of the asset's service life, the present value of the credit is $C_i q_i$, where

$$C_i = c_i/(1 + r)^1(1 + p)^1 \qquad i = 1,2, \ldots ,m \qquad (5)$$

Given the market price of the asset, equation (2) can be rewritten as

$$u_i = q_i[1 - C_i - T(1 - dc_i)B_i]/A_i(1 - T) \qquad (6)$$

$$i = 1,2, \ldots ,m$$

to solve for the implicit rental rate (u_i) that the firm must charge to earn the required real after-tax rate of return (r) [2] Equation (6) can also show how changes in tax laws may affect the rental rate For example, an increase in the real value of the invest ment tax credit, through a change in tax laws or a reduction in the inflation rate, will decrease the rental rate This decreased rental rate is observable by differentiating equation (6) with respect to the present value of the investment tax credit [3]

$$\partial u_i/\partial C_i = -q_i/A_i(1 - T) < 0 \qquad i = 1,2, \ldots ,m \qquad (7)$$

Because $q_i > 0$, $A_i > 0$, and $0 < T < 1$, the derivative $\partial u_i/\partial C_i < 0$

Similarly, equation (8) shows that an increase in the present value of the tax depreciation deductions also reduces the rental rate

$$\partial u_i/\partial B_i = -q_i T/A_i(1 - T) < 0 \qquad i = 1,2, \ldots ,m \qquad (8)$$

A change in the marginal income tax rate with respect to the rental rate, however, results in am biguous effects

$$\partial u_i/\partial T = q_i(1 - C_i - B_i)/A_i(1 - T)^2 \qquad (9)$$

$$i = 1,2, \ldots ,m$$

For example, a tax rate reduction reduces the tax on the rents generated by the asset and also reduces the value of the tax depreciation deductions In most cases, decreasing the tax rate will lower the rental rate However, equation (9) shows that decreasing the marginal income tax rate (T) increases the rental rate, provided $C_i + B_i > 1$ In other words, a decrease in the tax rate will cause rental rates to rise if the purchase price of the asset is less than the present value of the investment tax credit plus the present value of tax depreciation deductions If the purchase price is less than the present value of the credit and the depreciation deductions, the Government returns more than a dollar to the firm in tax saving for every dollar of investment

Data

As stated earlier, implicit rental rates are estimates of true rental rates that would exist under a given set of assumptions Therefore, it is important that I discuss the rationale for these assumptions, especially those regarding the economics characteristics of the assets, the tax parameters, and the discount rate

[2]The rental rate in equation (6) assumes the asset is completely depreciated and, therefore, could not be sold at the end of its service life However, equation (6) could be generalized to consider any salvage value and the tax consequences of a sale

When an asset is sold for an amount less than or equal to the original purchase price, the proceeds from the sale must be recaptured as ordinary income, with the present value of the pro ceeds (P) equal to

$$P = [1 - T][q(1 + g)^L/(1 + r)^L(1 + p)^L]$$

where g is the nominal growth rate in used asset prices

When an asset is sold for an amount greater than the original purchase price, that portion of the proceeds equal to the original purchase price must still be recaptured as ordinary income, and only the amount in excess of the purchase price is considered a capital gain for tax purposes The present value of the capital gain (G) can be represented as

$$G = [(q(1 + g)^L - q)/(1 + r)^L(1 + p)^L] - T(1 - j)[(q(1 + g)^L - q)/(1 + r)^L(1 + p)^L]$$

where the first part of the equation is the capital gain portion of the sale and the second part of the equation is the tax on the capital gain with j being the capital gains exclusion

Including both the ordinary income generated by the sale and the capital gain, if any, equation (6) can be recast as

$$u = [q[1 - C - T(1 - dc)B]/A(1 - T)] - P - G$$

[3]For simplicity, I assumed that the investment tax credit did not affect the basis for depreciation purposes

Economic Characteristics of Assets

I estimated rental rates for autos, trucks, tractors, long-lived farm equipment, crop storage structures, multipurpose structures, and unitary livestock facilities Asset price indexes for each of the four farm machinery categories were set equal to the respective Bureau of Labor Statistics (BLS) price index for passenger cars, trucks, wheel-type farm tractors, and agricultural machinery excluding farm tractors (*20*) A single price index series for all three structure categories was taken from the Bureau of Economic Analysis (BEA) capital stock study (*19*)

The service lives for each equipment category are based on averages of Bulletin F depreciation lives and are taken from Ball (*1*) The service lives for autos, trucks, tractors, and other long-lived equipment are 12, 11, 9, and 20 years, respectively [4] Unitary livestock facilities and multipurpose agricultural structures had service lives of 50 years, whereas the service life of crop storage structures was 25 years

The rate of economic depreciation for each category is approximated by the double-declining balance depreciation method where the capacity of the ith asset in year t of the asset's service life (L_i) is represented as

$$a_i(t) = [1 - (2/L_i)]^{t-1} \qquad i = 1,2, \ldots ,m \qquad (10)$$

for $1 \leq t \leq L_i$, and $a_i(t) = 0$ for $t > L_i$ To test the sensitivity of the capacity depreciation assumption, I also estimated rental rates assuming a "one-hoss shay" depreciation pattern (see appendix) where the capacity of the ith asset in year t is represented as

$$a_i(t) = 1 \qquad i = 1,2, \ldots ,m \qquad (11)$$

for $1 \leq t \leq L_i$, and $a_i(t) = 0$ for $t > L_i$ These rental rates are presented in the appendix of this article

Tax Lives, Investment Tax Credit, and Tax Depreciation Methods

The tax lives selected by farmers are based on the allowable lives which result in the greatest tax saving over the service life of the asset Greatly affecting the tax life, however, was the eligibility of the asset for the investment tax credit From 1962 to 1968 and again from 1971 to 1974, eligible assets (each machinery category and crop storage structures) with a useful life of at least 8 years received the full 7-percent investment tax credit [5] Eligible assets with a tax life of 6 or 7 years received two-thirds of the 7-percent credit From 1975 to 1979, the investment tax credit was increased to 10 percent, and the tax life requirement for each level of the credit was reduced by 1 year The tax savings associated with the investment tax credit was enough to offset the savings from selecting shorter tax lives As a result, I assumed that farmers selected the minimum allowable tax life which qualified for the entire investment tax credit Table 1 presents the tax lives for each category

Table 1—Tax lives for each asset category

Asset category	Tax life				
	1955-61	1962-68	1969 70	1971 74	1975 79
	Years				
Autos	6	8	3	8	7
Trucks	6	8	4	8	7
Tractors	10	10	10	8	8
Long-lived farm equipment	15	10	10	8	8
Crop storage structures	25	10	10	8	8
Unitary livestock facilities	50	25	25	20	20
Multipurpose structures	50	25	25	20	20

The tax depreciation methods chosen were also based on the tax savings generated by each of the allowable methods [6] From 1955 to 1969, assets in each category could have been depreciated under the

[4] Although the 9-year economic life of tractors is consistent with Bulletin F, some studies indicate that their economic life may be longer (*11*) Therefore, rental rates for farm tractors with a 12 year economic life have also been estimated

[5] Unitary livestock facilities became eligible for the credit in 1971

[6] Although not all farmers select a single depreciation pattern, data do not allow us to determine which methods are employed and to what extent each method is used To be consistent, I chose the option which resulted in the lowest rental rate

sum-of-year's-digits method or the double-declining balance method Under both alternatives, a portion of an asset could be depreciated at the straight line rate if the switch resulted in larger depreciation deductions The sum-of-year's digits with a switch to the straight line rate resulted in the greatest tax savings and was the selected method for each category From 1970 to 1979, each machinery category and crop storage structure were allowed the same accelerated depreciation methods allowed prior to 1970 However, unitary livestock structures and multipurpose structures were limited to a depreciation rate equal to 150 percent of the straight line rate

Discount Rate

I also had to specify the discount rate used to calculate the present value of the rents, investment tax credit, and the tax depreciation deductions, the discount rate is the opportunity cost to the investor of purchasing the asset As discussed by Eisner and Strotz (*3*), the appropriate interest rate used to represent the opportunity cost does not fall short of the investment horizon The discount rate used for equipment and structures is, therefore, a weighted average of the longrun real after-tax interest rate (external financing) and the expected longrun real after-tax return to equity (internal financing) Nominal interest charges are deductible from taxable income, and inflation reduces the real value of nominal interest and principal payments on debt When these two factors are considered, the real cost of external or debt financing (r_d) is

$$r_d = [r_n(1 - T) - p]/(1 + p) \qquad (12)$$

when r_n is the nominal interest rate After the real costs of both equity and debt financing are combined, the real cost of capital or real discount rate is

$$r = fr_d + (1 - f)r_e \qquad (13)$$

where f is the fraction debt financed, r_d is the real after-tax cost of debt financing, and r_e is the real after-tax return to equity (*13*)

Data from the 1969 and 1979 Farm Finance Surveys (*17, 18*) indicate that the fraction of farm investment that is debt financed is about 50 percent In keeping with Eisner and Strotz' theory that the appropriate interest rate should be a longrun rate, interest rates for external financing were rates charged by Federal Land Banks on new farm loans (*14, 16*). Following Coen (*2*) and Penson, Romain, and Hughes (*11*), I assumed the longrun real after-tax rate of return to equity was constant for each asset over the period studied Although there are few data regarding the appropriate longrun real after tax return to equity, Melichar found that the real total return to farm assets since 1950 has averaged about 8 percent (*10*) Gertel also found that the real before-tax return to cash rented farmland averaged 8 1 percent from 1940 to 1980 (*4*) Therefore, for this analysis I decided to use a real after-tax return to equity of 6 percent [7]

One can also respecify the discount rate to account for State and local property taxes If the property tax is correctly assessed, the property tax variable can be specified explicitly in the rental price equation or, because it increases the cost of capital, the variable can be specified in the discount rate (*7*) Accounting for the deductibility of property taxes from the Federal income tax and the fact that property taxes are generally levied in the current year but payable in the next year, I recast equation (13) as

$$r = fr_d + (1 - f)r_e + [(1 - T)K/(1 + p)] \qquad (14)$$

where K is the property tax rate expressed as a percentage of the value of the asset

Because many States exempt farm personal property from taxation, I assumed that property taxes were levied only on the three structure categories Property tax rates were taken from U S Department of Agriculture (USDA) estimates of farm real estate taxes (*6*)

Marginal Income Tax Rates

Finally, I developed an average marginal Federal income tax rate for new farm investment The marginal tax rate is the expected tax that an investor or firm would pay on an additional dollar of income prior to undertaking any new investment This tax rate is used to determine the rental rates

[7]The appendix to this article shows rental rates for long lived farm equipment under returns to equity of 3 percent and 9 percent

for farm capital It was necessary to create an average farm sole proprietorship Federal income tax return for the years data were available to estimate this marginal tax rate Starting with adjusted gross income, I replaced the amount of depreciation and interest deductions claimed for new investment After dividing by the number of businesses and subtracting the personal exemption, dependent credit, and, if applicable, the standard deduction or zero bracket amount, I estimated average taxable income [8] One can estimate the average marginal income tax rate by comparing the average taxable income with the appropriate tax table

Adjusted Gross Income. Adjusted gross income is gross income from all taxable sources reduced by adjustments such as the ordinary and necessary expenses of operating a trade or business Therefore, adjusted gross income combines both onfarm and off-farm income less total depreciation, interest, and other allowable farm business expenses Except for 1964 and 1965, the Internal Revenue Service (IRS) has published annual data on adjusted gross income for farm sole proprietorships from 1962 to 1979 (*22*) I used adjusted gross income rather than a narrower definition of income such as net income from farming because onfarm and off-farm income are interrelated Off-farm income finances farm investment, and farm-related expenses offset off-farm income

Tax Depreciation Deductions. Historically, IRS only publishes total depreciation deductions claimed in the current year, but it publishes neither data on farm investment nor allowances for depreciation deductions claimed on new investment Therefore, to calculate the marginal tax rate, I had to develop a procedure for separating the amount of depreciation claimed on new investment in the current year from depreciation deductions carried forward from investment in prior years Therefore, I depreciated investment data for trucks, tractors, other farm equipment, and structures published by USDA (*15*) over the selected tax lives Because there are no data regarding the actual depreciation method selected by farmers, I assumed that farmers selected the depreciation method and tax life which resulted in the greatest amount of tax savings over the economic life of each asset

Using investment data provided by USDA and the assumed tax life and depreciation method, I calculated the total farm depreciation pattern including the amount claimed on new investment in the current year I applied the percentage of first-year depreciation to IRS-published data on total depreciation deductions to estimate the IRS depreciation deductions claimed on new investment Except for 1968 and 1969 (during which the stimulus of the investment tax credit was only partially in effect), the percentage of tax depreciation deductions claimed for new investment in the first year increased steadily through time (table 2) Much of this increase results from increases in the nominal amount of investment rather than from changes in tax laws For example, gross farm capital expenditures, excluding farm households, increased from $4 5 billion in 1962 to $6 8 billion in 1967, it then fell to $6 1 and $6 2 billion in 1968 and 1969, respectively

Although the level of investment appears to be the most significant determinant of first-year depreciation, certain tax law changes have also had an impact In 1958, the introduction of the additional first year depreciation option allowed an additional deduction of 20 percent of eligible investment Revenue Procedure 62 21, enacted in 1962, significantly shortened the existing Bulletin F tax lives for many assets (*23*) In 1971, the Asset Depreciation Range (ADR) System allowed taxpayers to further reduce tax lives by 20 percent (*21*) However, the impact of reducing tax lives may have been limited because choosing the shorter tax life may have decreased the investment tax credit or eliminated the additional first-year depreciation deduction

Interest Paid Deduction. IRS publishes the total interest-paid deduction and does not separate interest expenses incurred for investment Therefore, I assumed that all IRS interest expenses were attributable to investment Furthermore, I calculated the percentage of interest charges on new debt using the data and methodology employed by USDA to estimate interest charges on farm real estate

[8] Because Schedule Y, the tax table used for this analysis, incorporates the standard deduction, there is no need to explicitly consider the standard deduction

Table 2—Gross farm investment, percentage of total tax depreciation deductions from new investment, total IRS tax depreciation, and IRS tax depreciation from new investment, 1962-79

Year	Gross farm investment	Total tax depreciation resulting from new investment	Total IRS tax depreciation deduction, sole proprietorships	IRS depreciation resulting from new investment
	Million dollars	*Percent*	*Million dollars*	
1962	4,473	27	3,177	858
1963	4,846	30	3,175	953
1964	5,101	32	3,253	1,041
1965	5 566	33	3,443	1,136
1966	5,095	35	3,693	1,292
1967	6,836	36	3,915	1,410
1968	6,112	32	4,126	1,320
1969	6,214	31	4,439	1,376
1970	6,793	32	4,598	1,471
1971	6,789	34	4,824	1,640
1972	7,480	36	5,290	1,905
1973	10,172	42	6,473	2,719
1974	11,444	42	7,189	3,019
1975	12,384	41	7,857	3,221
1976	13,968	42	8,845	3,715
1977	15,015	41	8,758	3,591
1978	17,948	43	10,208	4,389
1979	19,874	44	11,241	4,946

debt [8] I then applied that percentage to the IRS data on the interest-paid deduction to estimate the interest expenses resulting from new investment

Because the procedure used by USDA to estimate interest charges on real estate debt has already been explained in detail (*12*), only an overview will be presented here Loan and contractual interest rate data are from Federal land banks, life insurance companies, Farmers Home Administration, commercial banks, and individuals and others Loans outstanding at the beginning of each year and new loans made during the year are from primary sources (Farm Credit Administration, American Council of Life Insurance Companies, the Farmers Home Administration, and the Federal Deposit Insurance Corporation), except for loans from individuals and others which are benchmarked on Census of Agriculture data Data on interest rates are more tenuous in that the average interest rates on loans outstanding are all estimates, except for Federal land banks and the Farmers Home Administration Interest rates on new loans are based on surveys conducted by USDA and the Farm Credit Administration

I estimated total interest charges for each year by multiplying the average loans outstanding during the year for each year for each lender by the appropriate average interest rate on loans outstanding Multiplying the average interest rate on new loans by lender by the amount of new loans made during the year yields an estimate of interest charges resulting from new investment I then multiplied the percentage of total interest charges representing new investment by the IRS data on interest expenses to estimate the amount of interest expenses from debt incurred on new investment

[9] I considered only the USDA real estate debt series to exclude the short-term production loans contained in the nonreal estate debt category The nonreal estate debt category contains loans for recurring production items such as feed and seed Because these loans are short term the percentage of interest expenses on new loans relative to total interest expenses would be large and would inflate the percentage of total interest charges resulting from new investment

Table 3—Percentage of interest charges from new investment, total IRS interest charges, and total IRS interest from new investment, 1962-79

Year	Total interest charges resulting from new investment	Total IRS interest deduction, sole proprietorships	IRS interest deductions resulting from new investment
	Percent	*Million dollars*	
1962	30	902	269 10
1963	32	997	316 42
1964	32	1,064	340 79
1965	32	1,160	365 54
1966	31	1,358	414 50
1967	27	1,507	407 47
1968	26	1,708	439 64
1969	26	1,834	479 81
1970	24	2,035	487 16
1971	27	2,207	588 06
1972	34	2,459	829 48
1973	41	2,915	1,194 75
1974	38	3,256	1,219 47
1975	33	3,865	1,289 09
1976	33	4,595	1,528 80
1977	36	4,777	1,730 05
1978	28	5,872	1,636 00
1979	30	7,243	2,173 00

Table 3 shows estimates of the percentage of the total interest charges which represents interest charges on new investment, the IRS estimate of total interest deductions, and the estimated amount of IRS interest deductions resulting from new investment

Estimating Marginal Tax Rates. The final step in the estimation procedure was to sum adjusted gross income and the total tax depreciation and interest expenses resulting from new investment, I then divided that total by the number of farm business returns to estimate adjusted gross income per return I then reduced per-return adjusted gross income by the personal exemption and dependent credit to estimate taxable income [10] I then estimated the marginal tax rate by comparing taxable income with the appropriate tax table Table 4 presents per-return adjusted gross income (including tax depreciation and interest expenses on new investment), taxable income, and marginal income tax rate from 1962 to 1979 [11]

The marginal tax rate declined from 20 percent in 1962 and 1963 to 17 percent in 1965, it then increased to a high of 25 percent in 1978 (table 4) However, the decline in marginal tax rate from 1963 to 1965 was caused by the Revenue Act of 1964 rather than by a drop in taxable income The

[10] In addition to the personal exemption, I assumed that each return claimed three dependents Since 1955 both the personal exemption and the dependent credit have been equal, they increased from $600 in 1955 to $625 in 1970, to $675 in 1971, to $750 in 1972, and to $1,000 in 1979

[11] An example of the procedure for 1979 is as follows

Farms total, returns with and without adjusted gross income	
Adjusted gross income	$56,636,323,000
+Depreciation on 1979 investment ($11,241,468,000*0 44)	$4,946,245,920
+Interest on 1979 investment ($ 7,242,712,000*0 30)	$ 2,172,813,600
	$63,755,382 520
- Number of returns	2,921,934
	$21,820
-Personal exemption and three dependents	$4,000
Taxable income	$17,820

Table 4—Per return, adjusted gross income, taxable income, and marginal income tax rates, 1962-79

Year	Per return adjusted gross income	Per return taxable income	Per return marginal income tax rates
	Dollars		*Percent*
1962	4,853 33	1,968 00	20
1963	5,033 17	2,129 85	20
1964	5,907 53	2,916 78	20
1965	6,718 01	3,646 21	17
1966	7,028 83	3,935 39	17
1967	7,381 25	4,243 12	19
1968	8,128 65	4,915 78	19
1969	8,633 66	5,370 29	19
1970	8,869 38	5,482 44	19
1971	9,507 02	5,571 11	19
1972	11,404 88	6,694 15	19
1973	13,765 56	8,765 56	22
1974	14,311 56	9,311 56	22
1975	14,626 73	9,626 73	22
1976	15,814 81	10,442 59	22
1977	14,661 82	11,661 82	22
1978	19,833 01	16,833 01	25
1979	21,819 58	17,819 58	24

Revenue Act of 1964 reduced marginal income tax rates and narrowed the tax brackets, substantially increasing the progressiveness of the Federal income tax system For example, the minimum marginal tax rate in 1963 was 20 percent, and each tax bracket increased at $2,000 intervals below $22,000 in taxable income The minimum marginal tax rate was reduced to 14 percent in 1965, and the first four tax brackets were increased at $500 intervals

The lack of progressivity in the tax system prior to the Revenue Act of 1964 allows the estimation of marginal income tax rates prior to 1962 Because the lowest marginal tax rate applied was to taxable income below $2,000, the appropriate marginal tax rate would be the one which corresponded to the lowest tax bracket Therefore, the marginal tax rate from 1955 to 1961 was 20 percent For 1964 and 1965, I used USDA data (*15*) for onfarm and off-farm income as a proxy for adjusted gross income, the estimated marginal tax rate for 1964 was 20 percent, and the tax rate fell to 17 percent in 1965

Results

Rental rates for short-lived assets such as autos, trucks, and tractors are significantly higher than those for long lived assets such as long-lived equipment and structures (table 5) The higher rental rates are primarily the result of shorter economic lives of the assets rather than of differences in tax treatment The first major tax change during the period studied was the introduction of the investment tax credit in 1962 From 1961 to 1962, the rental rates fell from 0 1617 to 0 1489 for autos, from 0 1404 to 0 13 for trucks, from 0 1301 to 0 1236 for tractors (with a 9-year economic life), from 0 1029 to 0 0976 for tractors (with a 12-year economic life), from 0 0705 to 0 0656 for long-lived equipment, and from 0 0592 to 0 0533 for crop storage structures The fall in rental rates for autos and trucks was also moderated by the required use of a minimum 8-year tax life to qualify for the entire 7-percent credit Because the benefits of the credit outweighed the cost of selecting the longer life, I assumed that the tax lives of autos and trucks were increased from 6 to 8 years Unitary livestock facilities and multipurpose structures were not eligible for the investment tax credit when it was first introduced in 1962

In 1969 and 1970, the investment tax credit was repealed, and the rental rates for those assets which had previously qualified for the credit increased significantly The rental rate for autos increased from 0 1417 in 1968 to 0 1510 in 1969, and the rental rate for trucks increased from 0 1312 to 0.1426 The rental rates for both tractor categories and long-lived equipment increased from 0.1384 to 0 1562, from 0 1081 to 0 1219, and from 0 0716 to 0 0797, respectively The rental rates for unitary livestock facilities and multipurpose structures also increased from 1968 to 1969 However, these increases were a result of the rise in the price index of structures rather than the result of changes in tax laws.

In 1971, the investment tax credit was reinstituted, and unitary livestock facilities were added to the list of assets eligible to receive the credit IRS also introduced the Asset Depreciation Range (ADR) system Under the ADR system, tax lives could be reduced by as much as 20 percent However, rising asset prices moderated the reduction in rental rates

Table 5—Implicit rental rates for farm equipment and structures, 1955-79

Year	Autos	Trucks	Tractors (9)[1]	Tractors (12)[2]	Long lived farm equipment	Unitary livestock facilities	Crop storage structures	Multipurpose agricultural structures
				Rate				
1955	0 1408	0 1173	0 1062	0 0838	0 0567	0 0393	0 0554	0 0393
1956	1418	1216	1055	0824	0551	0369	0548	0369
1957	1497	1299	1124	0880	0588	0381	0558	0381
1958	1566	1368	1186	0933	0627	0403	0567	0403
1959	1617	1419	1241	0978	0660	0411	0573	0411
1960	1612	1395	1265	0999	0685	0417	0576	0417
1961	1617	1404	1301	1029	0705	0433	0592	0433
1962	1489	1300	1236	0976	0656	0410	0533	0410
1963	1470	1282	1247	0983	0661	0411	0538	0411
1964	1453	1268	1259	0994	0670	0426	0545	0426
1965	1426	1265	1268	0999	0672	0424	0553	0424
1966	1384	1247	1288	1009	0670	0415	0556	0415
1967	1410	1285	1342	1053	0705	0448	0591	0448
1968	1417	1312	1384	1081	0716	0451	0607	0451
1969	1510	1426	1562	1217	0797	0492	0723	0492
1970	1596	1534	1671	1309	0859	0582	0816	0582
1971	1621	1563	1625	1281	0846	0604	0824	0650
1972	1648	1582	1668	1313	0878	0629	0866	0677
1973	1520	1489	1603	1233	0789	0525	0808	0564
1974	1552	1592	1780	1352	0837	0529	0885	0567
1975	1783	1854	2180	1696	1130	0703	1014	0781
1976	1957	2066	2430	1908	1280	0803	1111	0894
1977	1997	2154	2581	2008	1308	0784	1140	0872
1978	2072	2277	2713	2089	1339	0776	1184	0863
1979	2121	2367	2884	2186	1335	0694	1182	0768

[1]9 year economic life
[2]12-year economic life

caused by the investment tax credit and the shorter tax lives

The importance of the investment tax credit is evident when one compares the rental rates for unitary livestock facilities and multipurpose structures The rental rates for unitary livestock facilities increased from 0 0582 in 1970 to 0 0604 in 1971, while the rental rate for multipurpose structures increased from 0 0582 to 0 0650 Prior to the reintroduction of the credit in 1971, unitary livestock facilities and multipurpose structures received identical tax treatment, they were assumed to have the same economic lives, and their prices were equal The only parameter which differed among the categories was that unitary livestock facilities were now eligible for the 7-percent investment tax credit

In 1974, a high inflation rate (12 2 percent) boosted rental rates for all categories dramatically Higher inflation rates increased rental rates by reducing the real value of the tax depreciation deductions and the investment tax credit Inflation also produces a bias between short- and long-lived assets Inflation affects short-lived assets more because a larger percentage of depreciation deductions are claimed earlier in the asset's life, reducing its real values by a greater amount For example, from 1974 to 1979, the rental rate for both tractor categories increased from 0 178 to 0 2884 and from

0 1352 to 0 2186, while the rental rate for long-lived equipment increased from 0 0837 to 0 1335

Estimated rental rates are significantly higher under a no-tax scenario (table 6) This situation does not imply that the tax system has actually reduced rental rates Instead, the no-tax scenario reflects the higher real return to equity (8 percent) and, because the interest expenses are no longer deductible, the higher real interest rates which were used to discount future returns [12] Table 6 also shows which asset groups have benefited most from the tax system Prior to 1962, rental rates for each asset category except tractors averaged about 2-3 percent higher under the no-tax scenario

From 1961 to 1968, rental rates are significantly higher under the no-tax scenario for each category, with rental rates for long-lived farm equipment and crop storage structures showing the largest increase This dramatic change is a result of shorter tax lives and the introduction of the investment tax credit in 1962 Although multipurpose structures and unitary livestock facilities were not eligible for the investment tax credit, their tax lives were reduced from 50 to 25 years This reduction raised rental rates by 7 percent in 1962 under the no tax

[12]In a no-tax scenario, the appropriate rate of return to equity is a before-tax return Therefore, I used an 8-percent real return to equity for the estimates in table 6 rather than the 6 percent real after tax rate of return used for the rental rates presented in table 5

Table 6—Percentage change in implicit rental rates under a no-tax scenario, 1955-79

Year	Autos	Trucks	Tractors (9)[1]	Tractors (12)[2]	Long-lived farm equipment	Unitary livestock facilities	Crop storage structures	Multipurpose agricultural structures
				Percent				
1955	2 56	2 22	0 19	1 31	2 65	2 80	1 81	2 80
1956	2 05	1 73	− 57	61	2 00	3 52	1 09	3 52
1957	2 14	1 69	− 62	57	2 04	3 41	1 08	3 41
1958	2 81	2 41	42	1 61	3 35	3 23	3 00	3 23
1959	2 91	2 47	48	1 74	3 33	3 16	2 97	3 16
1960	2 98	2 51	47	1 70	3 50	3 12	3 13	3 12
1961	3 03	2 64	69	1 94	3 55	2 77	3 38	2 77
1962	9 54	9 08	7 61	8 91	12 04	7 32	14 07	7 32
1963	9 46	8 97	7 46	8 75	11 95	7 30	14 13	7 30
1964	11 22	10 80	9 29	10 56	13 73	7 04	15 96	7 04
1965	11 15	10 67	9 23	10 51	13 69	7 78	15 55	7 78
1966	10 69	10 26	8 85	10 11	13 43	8 43	15 47	8 43
1967	10 78	10 35	8 72	10 07	13 48	8 04	15 74	8 04
1968	10 44	9 91	8 16	9 71	13 27	8 65	15 65	8 65
1969	4 17	3 16	− 26	1 23	4 77	9 35	7 19	9 35
1970	4 39	3 32	− 12	1 38	5 01	6 87	7 35	6 87
1971	10 92	10 36	9 42	10 93	14 54	15 40	16 87	7 23
1972	10 86	10 43	9 41	10 89	14 35	15 58	16 74	7 39
1973	9 34	8 73	7 55	9 25	13 81	18 10	16 96	9 93
1974	8 57	7 98	6 74	8 65	13 50	20 98	17 18	12 87
1975	14 58	13 92	12 16	13 97	16 73	20 63	21 50	8 58
1976	15 18	14 62	12 92	14 62	18 91	19 55	21 60	7 38
1977	14 62	13 97	12 20	13 99	18 43	20 66	21 32	8 49
1978	13 98	13 18	11 13	13 12	18 22	21 52	21 71	9 27
1979	12 68	11 96	9 71	11 89	17 75	25 65	21 83	13 54

[1]9 year economic life
[2]12-year economic life

scenario as opposed to a rise of only 3 percent in 1961. For autos, trucks, and tractors, tax lives were not reduced in 1962, but the investment tax credit caused 8-10 percent higher rental rates under the no-tax scenario Long-lived farm equipment and crop storage structures benefited most from the 1962 tax changes Tax lives for long-lived equipment were reduced from 15 to 10 years and from 25 to 10 years for crop storage structures Both long lived equipment and crop storage structures were eligible for the investment tax credit Shorter tax lives and the investment tax credit boosted rental rates 12 and 14 percent, respectively, under the no-tax scenario for long-lived equipment and crop storage structures These tax-induced advantages, measured in terms of rental rates, for equipment and crop storage structures continued through 1968 However, with the repeal of the credit in 1969 and 1970, the relative tax advantage shifted back toward unitary livestock facilities and multipurpose structures

The investment tax credit was reintroduced in 1972, and unitary livestock facilities were added to the list of assets eligible to receive the credit Tax lives for most assets were also reduced As in 1962-68, the rental-rate advantage from 1971 to 1979 shifted back toward assets which were eligible for the credit Assets such as crop storage structures, unitary livestock facilities, and long lived equipment, which were eligible for both the credit and significantly reduced tax lives, benefited most under the tax system

During 1955-79, Federal income tax policy greatly influenced rental rates among various farm assets Although no one asset category benefited most in all years, specific tax incentives such as the investment tax credit have created incentives to purchase relatively greater amounts of certain assets (table 6) The investment tax credit with relatively short tax lives has dramatically changed rental rates; crop storage structures, unitary livestock facilities, and long-lived farm equipment have received the largest benefits

Conclusions

The development of implicit rental rates for capital inputs is an important concept for understanding the effect of tax-induced changes on agricultural investment Changes in tax laws may distort relative rental rates among various asset categories, increasing demand for assets which receive more favorable tax treatment and decreasing demand for assets which receive less favorable tax treatment In the absence of other distortions, the resulting shift in investment decreases economic efficiency because the shift is a response to changes in tax laws rather than a response to market changes

The results of this analysis are conditioned on the assumptions used to estimate the rental rates and the necessity to use proxy-type data because conceptually correct data do not exist The implicit rental rates presented here are estimates of the true rental rates that would prevail under the given set of assumptions These caveats notwithstanding, the weight of this analysis suggests that tax policy has indeed affected rental rates for farm equipment and structures, and, as demonstrated in the appendix, this conclusion holds over a range of assumptions about real rates of return and an alternative assumption about capacity depreciation

More research is needed to determine the responsiveness of the food and fiber sector to changes in tax laws Researchers need to incorporate implicit rental rates into a longrun dynamic optimization framework where short, intermediate, and longrun investment responses can be quantified Given the fervor with which Federal income tax policy is employed as an incentive to spur investment, we need a broader understanding of how tax policy affects investment behavior

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Appendix

I developed the implicit rental rates presented in appendix table 1 under the assumption of a "one-hoss shay" capacity depreciation pattern to test the sensitivity of the capacity depreciation assumption The rental rates under the "one-hoss shay" depreciation pattern are significantly lower than those estimated under the double-declining balance method For example, rental rates for automobiles ranged from 0 1408 to 0 2121 under the double-declining balance assumption whereas rental rates ranged from 0 0681 to 0 0945 under the "one-hoss shay" assumption Although the "one-hoss shay" capacity depreciation assumption did affect the magnitude of the estimates, it did not significantly affect the ranking of the seven asset categories Rental rates for autos, trucks, and tractors remained significantly higher than those for long-lived equipment and structures

In addition to the capacity depreciation assumption, a second important assumption regarding the rental rates estimates is the required real after-tax return to equity To test the sensitivity of this assumption, I also estimated rental rates for long-lived farm equipment with real after-tax returns to equity equal to 3 and 9 percent Appendix table 2 shows the results of the alternative rates of return to equity Rental rates estimated under a 3-percent real after-tax return to equity average about 10 percent lower than rental rates estimated under the 6-percent real after-tax return to equity assumption, rental rates estimated under the 9-percent assumption average about 10 percent higher than rental rates estimated under the 6-percent assumption

Appendix table 1—Implicit rental rates for farm equipment and structures, 1955-79

Year	Autos	Trucks	Tractors (9)[1]	Tractors (12)[2]	Long lived farm equipment	Unitary livestock facilities	Crop storage structures	Multipurpose agricultural structures
					Rate			
1955	0 0681	0 0565	0 0508	0 0405	0 0285	0 0239	0 0294	0 0239
1956	0671	0574	0496	0390	0268	0211	0279	0211
1957	0712	0616	0531	0418	0288	0221	0287	0221
1958	0753	0655	0565	0449	0313	0241	0297	0241
1959	0781	0683	0593	0473	0332	0249	0303	0249
1960	0782	0674	0607	0484	0346	0256	0307	0256
1961	0788	0681	0626	0501	0359	0269	0318	0269
1962	0722	0628	0593	0473	0331	0252	0284	0252
1963	0710	0617	0596	0475	0332	0250	0285	0250
1964	0705	0612	0604	0482	0338	0261	0290	0261
1965	0689	0608	0606	0482	0337	0257	0292	0257
1966	0660	0593	0610	0481	0330	0243	0287	0243
1967	0675	0613	0637	0504	0349	0265	0308	0265
1968	0672	0620	0652	0513	0349	0260	0311	0260
1969	0712	0671	0733	0574	0385	0280	0367	0280
1970	0761	0730	0791	0625	0423	0343	0423	0343
1971	0784	0753	0778	0619	0425	0369	0438	0397
1972	0794	0759	0796	0633	0439	0380	0457	0409
1973	0697	0683	0736	0565	0365	0271	0387	0291
1974	0694	0713	0802	0605	0372	0249	0403	0267
1975	0838	0869	1020	0797	0535	0390	0507	0433
1976	0937	0986	1154	0914	0634	0471	0575	0525
1977	0938	1010	1207	0943	0628	0432	0567	0480
1978	0952	1047	1248	0960	0622	0396	0564	0441
1979	0945	1057	1295	0974	0590	0315	0529	0348

[1]9 year economic life
[2]12 year economic life

Appendix table 2—Implicit rental rates for long-lived farm equipment under alternative real after-tax returns to equity, 1955-79

Year	r_e = 0 03	r_e = 0 06	r_e = 0 09
	Rate		
1955	0 0510	0 0567	0 0625
1956	0494	0551	0610
1957	0528	0588	0650
1958	0566	0627	0691
1959	0595	0660	0726
1960	0619	0685	0753
1961	0637	0705	0775
1962	0593	0656	0721
1963	0597	0661	0727
1964	0605	0670	0737
1965	0608	0672	0739
1966	0604	0670	0738
1967	0636	0705	0777
1968	0644	0716	0790
1969	0718	0797	0878
1970	0776	0859	0945
1971	0766	0846	0929
1972	0793	0878	0965
1973	0704	0789	0877
1974	0743	0837	0935
1975	0998	1130	1232
1976	1153	1280	1411
1977	1173	1308	1447
1978	1194	1339	1491
1979	1182	1335	1497