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An economic evaluation of the cash and accural accounting systems for farmers

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by

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INTRODUCTION

Tax Planning for Farmers

Tax planning is an important consideration for the successful farm manager. The significance of tax management and planning has been long recognized. In 1937 Rowe and Wright indicated that "Each new revenue bill enacted by Congress stamps on the mind of the individual the increasing importance of taxes not only to the man of means but to John Doe, the average business man or merchant. He reads taxes and talks taxes but more important he pays taxes (20).

Data from the Economic Research Service points out more vividly the importance of tax and tax planning for U. S. farmers. The data for average before tax gross income, taxable income, tax liability, and taxes as a percent of gross income for United States farmers in 1970 show the following (2):

Average before tax gross income	-	$8,850
Average taxable income	-	5,270
Average tax liability	-	1,210
Tax/gross income	-	13.7%

It can be seen that taxes in 1970 represented an important (13.7%) liability or expense when compared to gross income.

The tax liability as a percent of gross income concept, when calculated for Iowa Farm Business data, yields the results summarized in Table 1.

Table 1 indicates that tax management decisions have the most potential significance on grain farms. Larger farms within each farm type have more potential savings from tax management than smaller farms.

Table 1. Tax/gross profits, for Iowa Farms, 1974

	Grain Farms	Livestock Farms	Dairy Farms
Class II[a]	10.2%	7.1%	5.4%
Class 0[b]	25.6%	12.2%	18.6%

[a]Class II farms are those farms with agricultural sales between $20,000 and $40,000.

[b]Class 0 farms are those farms with agricultural sales over $100,000.

There are many decisions that must be made by the farmer in the development of a tax management plan. These decisions concern such items as depreciation, investment credit, accounting methods, fiscal verses calendar year, type of farm organization, inventory valuation methods, and income averaging (19).

Depreciation is the allocation of the expense associated with purchasing a capital asset. There are three basic methods of depreciation (1) straight line, (2) sum of the years digits and (3) declining balance. These three methods differ in how rapidly the capital purchase is written off as an expense. The choice of one method over another will allow different amounts of expense to be written off in a given year, thus changing the tax liability for that year (7). Special depreciation rules as the Asset Depreciation Range and the 20 percent first year allowance, when used in addition to the three depreciation methods, can increase the amount of depreciation expense declared in any one year. However, these special rules change only the timing of the depreciation expense and do not increase the total amount that can be taken (7).

Investment credit is a deduction dollar for dollar in the tax liability when qualifying business property is purchased. In 1975 and 1976, 10 percent of the cost of this property can be used to offset the tax liability if the asset is held seven years or more. If the property is held five or six years the percentage figure is 6.7 percent, three or four years it is 3.3 percent. No investment credit can be taken if the property is held less than three years (22).

The accounting method used by a business can save taxes or postpone the tax liability. Two basic types of accounting methods are available for use by farmers: (1) the cash method, (2) the accrual method. The publication Tax Loss Farming points out the role of accounting method in tax planning. "As farmers taxable incomes, income tax rates, and accompanying tax burdens have increased over the years, the cash method (of accounting) has become an excellent means of minimizing and postponing income tax payments" (22). McDoulett and Halloman draw a similar conclusion, "one of the most important features of the cash method is that it allows the taxpayer to exercise a great deal of control over his taxable income" (17).

The cash method allows expenses and income to be recorded as such in the year cash changes hands regardless of when the expense or income was accrued. Under the accrual method expenses and income are recorded as such in the year they accrue regardless of when they are paid. The flexibility under the cash system allows prepayment of some accrual expenses. It also allows income to be changed by altering sales or postponing receipt of income accrued. This flexibility allows the tax liability to be adjusted.

O'Byrne uses an example of a wheat farmer to point out this flexibility. The farmer raised $10,400 of wheat in one year. He sold half of this crop one year and half the next year (19). The taxable income and tax liability for two years are compared for the cash and accrual methods in Table 2.[1]

Table 2. Cash and accrual income and tax liability

	Cash method		Accrual method	
	Taxable income	Tax liability	Taxable income	Tax liability
Year 1	$ 5,200	$ 932	$10,400	$2,198
Year 2	5,200	932	0	0
Total	$10,400	$1,864	$10,400	$2,198

Under the accrual method the $10,400 of wheat raised in year 1 must be recorded as income in that year. This results in a $2,198 tax liability. Under the cash method $5,200 of wheat is sold each year. This results in a $932 tax liability each year.

The tax liability in year 1 is reduced $1,266 by using the cash method. There are two reasons for this reduction. First, only half the accrual income was reported under the cash method so there should be at most only half the tax liability if cash and accrued income are taxed at the same rate. Second the lower taxable income under the cash method is taxed at a lower marginal rate than income reported using the accrual method.

The total two year tax liability is reduced by $334. This is a result of the lower marginal tax rate on cash reported income. This income saved

[1]This example assumed no expenses associated with growing the wheat during either year (i.e., gross income equals taxable income).

from taxation can be used to increase consumption and growth rate of the farm.

Problem Statement

The basic problem a farmer is confronted with when he uses the cash method for reporting taxable income is how to adjust receipts and expenses in such a way that he maximizes his total after tax income over a number of years. When each year is considered by itself, he would make these adjustments so that after-tax income is maximized each year without regard to the effects of this decision on taxable income in future years. However, when a multi-year planning horizon is considered, this maximization process involves the additional considerations of the effect on future year's taxable income from adjustments taken in a previous year, and the time value of money. Money saved from taxes this year is preferred to the same amount of money saved in future years.

If one properly uses the cash method over a given number of years to report taxable income, it is hypothesized that he would be better off financially than if he uses the accrual method. However, the specific economic impact of using the cash verses the accrual method over a given number of years is not well understood conceptually, and no empirical method exists to test the actual economic differences.

The knowledge of the economic differences between cash and accrual accounting systems is important for two reasons. First it will aid farm owners and operators in understanding and actually analyzing the importance of choosing an accounting method as well as how to manage the deductions available with different systems over time. Second, many non-farm investors

are using the liberal cash accounting rules in tax shelters. Congress and the Internal Revenue Service are considering proposals to reduce these tax shelters. Carlin and Woods note some of these proposed changes (2). Some Congressmen want a limit imposed on the amount of farm losses that can be used to offset non-farm income. Others are in favor of the more drastic measure of eliminating the cash method and its liberal accounting rules completely. If the latter proposal is considered, farm operators will be affected in addition to the non-farm investors. The affect that eliminating the cash method of accounting will have on all types and sizes of farms must be determined before an intelligent decision on a proposal of this nature can be made.

Objectives of Study

The objectives of this study are threefold:

(1) The cash and accrual methods of accounting will be described and compared from an institutional and legal standpoint. This will provide basic background for the development of economic models that can be used to explain the impact on the farm of accounting methods.

(2) A conceptual model based on economic theory will be developed to aid in understanding the economic impacts of different accounting methods. This model will point out basic parameters, procedures, and principles needed for developing an empirical model to actually measure these impacts.

(3) An empirical model will be developed by numerically defining parameters and principles obtained from the conceptual model. The model will be used to calculate after tax income, consumption, net worth, and growth rate for the farm for a five year period for both the cash and accrual methods of accounting. By changing certain parameters, the empirical model will be adaptable for use on various types and sizes of farms. This empirical analysis will provide information on possible differences in the use of accounting methods and their impact for different size and types of farms.

Review of Literature

Harrison performed a general tax analysis of tax returns for U. S. farmers (11). These returns were analyzed to determine the degree to which cash and accrual methods were used by farmers for reporting taxable income. This study was performed for all farms in aggregate and for farm enterprise types. The results of this study are summarized in Table 3.

There was an obvious preference among farmers for the cash method when reporting taxable income. The statistics from Table 3 show only 2.7 percent of the tax returns from all farms in 1968 used the accrual method. This represented 7.6 percent of the total reported gross receipts.

Conclusions drawn and possible explanations for these results were: (1) the cash method is a simple method of reporting income as inventory accounts are not needed, (2) taxes can be postponed when inventory increases occur, (3) more flexibility is provided in adjusting taxable income from

Table 3. Farm proprietorships: total receipts, deductions, and profits, by accounting method and farm industry, 1968 (money amounts in thousands of dollars)

Accounting method, item	All farms	Field crop farms	Fruit, tree nut, and vegetable farms	Livestock farms	Animal specialty farms	Other farms
All farms:						
Number of farms	3,042,564	1,200,523	139,942	1,470,833	57,303	173,963
Farm receipts	35,017,457	10,980,912	1,907,282	21,143,282	215,539	770,442
Total deductions	31,892,608	9,275,865	1,770,911	19,711,386	318,557	815,889
Net profit (less loss)	3,124,849	1,705,047	136,371	1,431,896[a]	103,018[a]	45,447
Cash basis farms:						
Number of farms	2,961,067	1,186,225	139,123	1,415,670	52,936	167,113
Farm receipts	32,353,803	10,555,826	1,856,747	19,107,672	189,683	643,875
Total deductions	29,362,856	8,903,087	1,724,309	17,759,284	281,512	694,664
Net profit (less loss)	2,990,947	1,652,739	132,438	1,348,388[a]	91,829[a]	50,789
Accrual basis farms:						
Number of farms	81,497	14,298	819	55,163	4,367	6,850
Farm receipts	2,663,654	425,086	50,535	2,035,610	25,856	126,567
Total deductions	2,529,752	372,778	46,602	1,952,102	37,045	121,225
Net profit (less loss)	133,902	52,308	3,933	83,508[a]	11,189	5,342

[a]Net loss exceeds net profit.

from year to year, and (4) sale of raised capital assets may result in a lower tax liability.

Numerous articles have been written about specific economic impacts of different accounting methods. O'Byrne gives specific examples of the impacts of accounting methods, fiscal verses calendar year, and investment credit on "real farmers" (19).

Carmon analyzed tax shelters that make use of the liberal accounting rules afforded by the cash method. He concludes the cash method of accounting allows development of raised capital assets to be deducted as current expense while sale of these assets is considered capital gain income. Capital gain income is taxed at a maximum rate of 25 percent. This aspect of the cash method allows a non-farm investor to show a before-tax loss on the farm investment while actually having an after-tax gain on his combined income (5).

In another article, Carmon discussed proposed changes in the tax law. One change presented was limiting to $15,000 the amount of farm losses that could be deducted against non-farm incomes. Another change evaluated was the establishment of an "Excess Deductions Account". Taxpayers with non-farm income of over $50,000 would have to place farm losses over $25,000 in this account. The taxpayer would have to pay ordinary tax rates on this account before he could claim capital gains on breeding livestock, orchards, or land improvements. He concludes that if these proposals were adopted, "tax planning opportunities still exist in agriculture, especially in the conversion of ordinary income to capital gains. Farmers have benefitted from farm tax provisions but not in the spectacular manner of some wealthy, urban investors" (5).

Martin and Gatz state that 1967 cattle ranch prices were higher than they should have been based on a budget analysis because of tax regulations (18). They concluded the tax shelter benefits of the cash method allowed non-farm investors to realize a higher combined after-tax income from cattle ranch investments. This drove the price of these ranches up. Dean and Carter used economic theory to explain conceptually the results Martin and Gatz found empirically (6).

McDoulett and Hallaman discussed tax planning decisions and how they affect actual working cattle operations in Oklahoma. They evaluated the effect of a fiscal verses calendar year, accounting methods, and inventory valuation methods.

James and Stoneberg list some of the advantages of deferring taxes in their book Farm Accounting and Business Analysis. They state income deferred from taxes can be used to increase family living expenses, increase farm net worth, and allows greater financial leverage (16).

Harl addressed the question "Do Rules Favor Large Scale Agricultural Firms?". He reviewed various state and federal regulations relative to this question, and concluded, "the tax structure does not discriminate systematically against small-scale farmers and for large scale farmers. However, the corporate tax structure does provide strong encouragement for corporate operation by high-tax-bracket individuals" (10).

This study will use the knowledge gathered from previous literature as a foundation but extends previous work on accounting methods in two

important ways. First, the effects of using different accounting methods over a five year period will be analyzed. Typically, one or two year periods have been used in previous studies. Second, the basic decision variable used in maximizing five year taxable income under the cash method will be additional cash deductions. Previous work has not typically treated this as a decision variable.

The conceptual model for this study will be developed in Chapter II. First, the cash and accrual accounting method will be described from a legal and institutional standpoint. This will be used as a foundation for the development of a multi-period after-tax income equation. This equation will be maximized with respect to additional cash deductions. This maximization process will conceptually demonstrate how additional cash deductions should be declared to maximize multi-period after-tax income. Using parameters defined and techniques described in Chapter II, an empirical model will be developed in Chapter III. This empirical model will be used to measure the financial effects and tax implications of different accounting methods for farms in different enterprise types and economic size classes. Chapter IV of this study will summarize results of the empirical analysis for each farm size and enterprise type studied. Finally, a summary and implications for further study will be presented in Chapter V.

CONCEPTUAL MODEL

Legal and Institutional Framework

Farmers can choose between two basic accounting methods for reporting taxable income. The choice of an accounting method is usually made when the first tax return is filed, and it cannot be changed without consent of the Commissioner of the Internal Revenue Service (11).

The two basic allowable accounting methods are cash and accrual. Farmers using the accrual method report income and expenses as such in the year they are accrued regardless of when payment takes place. These income and expense items are adjusted by inventory changes to arrive at taxable income. Farmers using the cash method report income and expenses as such in the year payment takes place regardless of when they were accrued. No adjustment is required for inventory changes.

Accrual method income

Farmers using the accrual method have two types of income (1) cash income, and (2) non-cash income. Cash income is income derived from the sale of goods and services for cash. Kinds of transactions that result in cash income are (1) crop sales, (2) market livestock sales, (3) government payments, (4) dividends, (5) rent received, and (6) custom work (16).

Non-cash income is income derived from the sale of goods and services, where payment is in a form other than cash. There are three kinds of transactions that result in non-cash income: (1) home used products, (2) payment in kind income, and (3) inventory increases. Home used

products are crops or livestock raised for sale that are consumed rather than sold. Payment in kind is income generated in a form other than cash (16).

Accrual method expenses

Expenses under the accrual method are of three types, (1) cash variable expense, (2) cash fixed expense, and (3) non-cash expense. Cash variable expenses involve a cash outlay for the purchase of variable inputs. Variable inputs are inputs who's amount of use will vary in the short run with market conditions. Livestock feed, crop fertilizer, hired labor, and machine hire are examples of variable inputs (16).

Cash fixed expenses involve a cash outlay for the purchase of fixed inputs. Fixed inputs are inputs whose amount of use is fixed in the short run. Insurance, land rent, and interest are examples of fixed inputs (16).

Non-cash expenses do not involve a cash outlay. There are three kinds of non-cash expenses (1) payment in kind, (2) depreciation, and (3) inventory decreases. Payment in kind is a payment in a form other than cash. Depreciation is the allocation of the expense associated with a capital asset purchase.

Accrual inventory adjustment

Inventory changes are non-cash transactions that result because of changes in price, quantity, or both, of crops, market livestock and supplies. In order to calculate inventory change, a specific method must be used to value the inventory each year. Farmers can use four

methods to value their inventory: (1) cost, (2) cost or market which ever is lower, (3) unit livestock, and (4) farm price (19).

Under the cost method, inventory items are valued at the actual cost of production. Inventory items that are purchased are valued at actual purchase price plus any additional cost incurred from the time of purchase to the time of inventory valuation.

Under the cost or market whichever is lower method, each inventory item is valued using the cost method. This value is compared with the current market price of the item, and the lower of the two values is used.

Under the unit livestock method, livestock are grouped according to kind and age. A standard unit price is assigned to each group, and this price is used as the value for each animal in that group.

Under the farm price method, every item is valued at its market price less any direct costs associated with disposition of the item. Farmers can select any one of these methods to value their inventory. However, a change in valuation methods generally requires consent of the Internal Revenue Service (11).

Cash method income

Farmers using the cash method have the same two types of income as farmers using the accrual method. However, income under the cash method can differ from income under the accrual method because inventory increases are not recorded as non-cash income, and accounts receivable transactions are handled differently.

Accounts receivable is income accrued at a different time than when payment was received. If the income was accrued in one year and

payment takes place in another year, the accrual income will differ from the cash income for each year. For example, a farmer performs $100 worth of custom combining in November of 1974, and in January of 1975 he is paid for his work. His income for the two years using the accrual and cash methods is summarized in Table 4.

Table 4. Accrual and cash income for 1974 and 1975

	1974	1975
Accrual income	$100	$ 0
Cash income	$ 0	$100

Cash method expenses

Farmers using the cash method have the same three types of expenses as farmers using the accrual method.[1] However, expenses under the cash method can differ from expenses under the accrual method because inventory decreases are not recorded as non-cash expense; also interest and open account expense transactions are handled differently.

Interest is the expense associated with using borrowed money. If interest was accrued in one year and payment takes place in another year, the accrual interest expense will differ from the cash interest expense in each year. The Internal Revenue Service has ruled that interest

[1] The cash method has one requirement concerning the cost of livestock purchased for resale that does not exist under the accrual method. Under the cash method the cost of buying feeder livestock cannot be recorded as an expense in the year the purchased livestock are sold.

prepaid by a cash basis taxpayer more than one year in advance is considered to distort income in the year of payment.[1] However, if interest is prepaid one year or less in advance, the Internal Revenue Service will allow it to be used as an expense if it does not distort income for that year (19). For example, a farmer has an interest expense of $45 for 1974 and 1975. If he prepays this interest one year in advance in 1974, his cash and accrued interest expense for the two years are shown in Table 5.

Open accounts expense is an expense accrued at a different time than it was paid. If a particular expense is accrued in one year and paid in another, such as with a feed purchase, the accrual expense will differ from the cash expense in a given year. The Internal Revenue Service has stated that open accounts can also be prepaid one year in advance if the advance expenditure is (1) a payment and not a deposit, (2) made for a business purpose, and (3) does not distort income (2). For example, if a farmer gets $500 worth of repair work done in December of 1974 and pays for it in January of 1975 his cash and accrual open account expense for the two years are shown in Table 5.

Methods of accounting used to report taxable income sometimes have aspects of both the cash and accrual methods. One hybrid method uses the cash method of accounting but also includes inventory changes to adjust taxable income. Another method uses the accrual method for all income and expenses except miscellaneous entries. The cash method is used for these.

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[1] Prepayment of interest defies theory because interest expense is a function of time. However, it is done on a practical basis.

Table 5. Accrual and cash expense for 1974 and 1975

	1974	1975
Accrued interest expense	$ 45	$ 45
Cash interest expense	90	0
Accrued open account expense	500	0
Cash open account expense	0	500

The strict cash and accrual methods represent extremes in accounting. The hybrid methods fall somewhere between these extremes. The greatest affect of accounting methods on taxable income and tax savings can be determined by comparing the extremes, namely cash and accrual accounting system.

Economic Framework

Using the above legal and institutional framework, the variable "additional cash deductions" can be utilized to contrast cash method after-tax income and accrual method after-tax income. A multi-period after-tax income equation can be constructed to show inter-period relationships of after-tax income. Once the difference between cash and accrual method after-tax income is understood, and the inter-period relationship of after-tax income is known, the levels of after-tax income, consumption, increased net worth, and growth rate for a farm firm can be calculated for both the cash and the accrual methods.

Multi-Period After-Tax Income

A five period after-tax income equation is used as the basis for determining inter-period relationships of after-tax income.

$$(1) \quad \pi = \sum_{t=1}^{5} \frac{B_t - f(NFI_t^c)}{(1+\alpha)^t}$$

π = five year after-tax income

B_t = accrued net farm income before taxes in period t

$f(NFI_t^c)$ = tax liability in period t

NFI_t^c = taxable net farm income in period t

α = rate of discount as measured by the before-tax income generated from a one dollar increase in net worth

Accrued before-tax income

Accrued before-tax income (B_t) is defined in equation 2 (15).

$$(2) \quad B_t = rA_t - iD_t + WH$$

r = net rate of return on assets

A_t = value of assets at the beginning of period t

i = average interest rate on liabilities in period t

D_t = value of liabilities at the beginning of period t

WH = yearly value of operator labor

Equation 2 indicates the relationship between income and the value of assets and liabilities. When the variables A_t and D_t in equation 2 are expanded to include consumption, they show the inter-year relationship of after-tax income. Consumption is defined as:

$$(3) \quad C_t = N(B_t - f(NFI_t^c)) + M$$

N = marginal propensity to consume

M = minimum consumption level

If it is assumed all after-tax income not consumed increases net worth, net worth increases can be defined as:

$$(4) \quad CNW_t = (1 - N)(B_{t-1} - f(NFI^c_{t-1})) - M$$

A_t and D_t can be defined as:

$$(5) \quad A_t = A_{t-1} + Z[(1-N)(B_{t-1} - f(NFI^c_{t-1})) - M]$$

where Z is one plus the percent borrowing on new net worth.

$$(6) \quad D_t = D_{t-1} + (Z-1)[(1-N)(B_{t-1} - f(NFI^c_{t-1})) - M]$$

If equation 5 is substituted for A_t and equation 6 is substituted for D_t in equation 2, we have:

$$(7) \quad B_t = r[A_{t-1} + Z[(1-N)(B_{t-1} - f(NFI^c_{t-1})) - M]] - i[D_{t-1} (Z-1)[(1-N)(B_{t-1} - (NFI^c_{t-1})) - M]] + WH$$

Simplifying equation 7 we obtain:

$$(8) \quad B_t = B_{t-1} + (rZ - i(Z-1)[(1-N)(B_{t-1} - f(NFI^c_{t-1})) - M]$$

The parameter α in equation 1 is equal to (rZ - i(Z-1)) so equation 8 can be further simplified:

$$(9) \quad B_t = B_{t-1} + \alpha[(1-N)(B_{t-1} - f(NFI^c_{t-1})) - M]^1$$

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[1]This equation assumes a constant rate of return on assets from year to year.

Equation 9 indicates the inter-period relationship of before tax income. Before-tax income this year is equal to last years net income plus incremental rate of return on new net worth generated last year. If before-tax incomes are related, after-tax incomes are also related because after-tax income is a function of before-tax income:

$$(10) \quad DI_t = B_t - f(NFI_t^c)$$

DI_t = after-tax income in period t

Taxable net farm income

Taxable net farm income (NFI_t^c) is defined as:

$$(11) \quad NFI_t^c = B_t - AD_t$$

AD_t = actual amount of accrued expenses that are prepaid and income that is postponed[1] (i.e., additional cash deductions)

When the accrual method is used to report taxable income, no additional cash deductions can be declared (i.e., $AD_t = 0$), so taxable income (NFI_t^c) is equal to accrued net farm income before taxes (B_t). If the cash method is used to report taxable income, additional cash deductions can be declared (i.e., $AD_t > 0$). This results in a difference between the cash and the accrual method when before-tax income is calculated. Through equation 11 we also see the contrast for after-tax income.

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[1] For a more detailed discussion of AD_t see Appendix 1.

Equation 1 can now be expanded to show the interperiod relationship of after-tax income, and the contrast between the cash and the accrual methods of accounting:

$$(12)\quad \pi = \sum_{t=1}^{5} \frac{B_{t-1} + \alpha[(1-N)[B_{t-1} - f(B_{t-1} - AD_{t-1})] - M] - f(B_t - AD_t)}{(1+\alpha)^t}$$

Maximization of After-Tax Income

Traditional optimization

If a farmer uses the accrual method for reporting taxable income, he cannot declare any additional cash deductions. If B_1 is given, and α, N, and M are assumed, π can be calculated by using equation 12. However, if the farmer uses the cash method his additional cash deductions (AD_t) are not zero. The cash method farmer can regulate his additional cash deductions (AD_t) in such a way as to maximize equation 12. If equation 12 is maximized with respect to AD_t, the partials $\frac{\partial \pi}{\partial AD_1}$, $\frac{\partial \pi}{\partial AD_2}$, $\frac{\partial \pi}{\partial AD_3}$, $\frac{\partial \pi}{\partial AD_4}$, and $\frac{\partial \pi}{\partial AD_5}$ must all equal 0. These conditions are specified in equations 16 through 20.

The variables E_t, X_t, and Y_t in equations 16 through 20 are defined similarly for each equation. Equation 16 will be used as an example. E_t is the marginal dollars saved from taxes in period t from a one dollar increase in AD_1. E_1 is equal to:

$$(13)\quad E_1 = \frac{\partial f(B_1 - AD_1)}{\partial AD_1}$$

X_t is the before-tax dollars earned in period t-1 from net worth increases in periods 1 through (t-2) because of a one dollar increase in AD_1. X_3 is equal to:

$$(14) \quad X_3 = \alpha(1-N)E_1$$

Y_t is before-tax income earned in period t from the net worth increase in period (t-1) because of a one dollar increase in AD_1. Y_3 is equal to:

$$(15) \quad Y_3 = (\alpha(1-N)E_1)(1-E_2)$$

The specific $\frac{\partial \pi}{\partial AD_t}$ conditions then are:

$$(16) \quad \frac{\partial \pi}{\partial AD_1} = \frac{E_1}{(1+\alpha)} + \frac{(\alpha(1-N)E_1)(1-E_2)}{(1+\alpha)^2} + \frac{(X_3 + \alpha(1-N)Y_3)(1-E_3)}{(1+\alpha)^3} +$$

$$\frac{(X_4 + \alpha(1-N)Y_4)(1-E_4)}{(1+\alpha)^4} + \frac{(X_5 + \alpha(1-N)Y_5)(1-E_5)}{(1+\alpha)^5} = 0$$

$$(17) \quad \frac{\partial \pi}{\partial AD_2} = \frac{E_2}{(1+\alpha)^2} + \frac{(\alpha(1-N)E_2)(1-E_3)}{(1+\alpha)^3} + \frac{(X_4 + \alpha(1-N)Y_4)(1-E_4)}{(1+\alpha)^4} +$$

$$\frac{(X_5 + \alpha(1-N)Y_5(1-E_5)}{(1+\alpha)^5} = 0$$

$$(18) \quad \frac{\partial \pi}{\partial AD_3} = \frac{E_3}{(1+\alpha)^3} + \frac{(\alpha(1-N)E_3(1-E_4)}{(1+\alpha)^4} + \frac{(X_5 + \alpha(1-N)Y_5)(1-E_5)}{(1+\alpha)^5} = 0$$

$$(19)\quad \frac{\partial \pi}{\partial AD_4} = \frac{E_4}{(1+\alpha)^4} + \frac{(\alpha(1-N)E_4)(1-E_5)}{(1+\alpha)^5} = 0$$

$$(20)\quad \frac{\partial \pi}{\partial AD_5} = \frac{E_5}{(1+\alpha)^5} = 0$$

Equating equations 16 through 20 to zero insures a maximum for equation 12 if no constraints are placed on the AD_t's. However, as noted in Appendix 1 all the AD_t's are constrained by the values for the $AD_{(t-1)}$'s. Because of these constraints, the farmer cannot equate equations 16 through 20 to zero. But if he wants to maximize equation 12 subject to these constraints, he should use the unconstrained optimization spelled out in equations 16 through 20 as a guide.

Linear approximation

The unconstrained relationship among the adjusted marginal tax rates is conceptually stated in equations 16 through 20. These equations are non-linear because marginal tax rates (E_t) are multiplied by each other. Solution values for E_1 through E_5 can only be determined through complex numerical analysis techniques because of this non-linearity. If before-tax rather than after-tax implications are used to analyze the affects of a dollar increase in additional cash deductions, equations 16 through 20 become linear and are:

$$(21)\quad \frac{\partial \pi}{\partial AD_1} = \frac{E_1}{(1+\alpha)} + \frac{\alpha(1-N)}{(1+\alpha)^2}E_2 + \frac{\alpha^2(1-N)^2}{(1+\alpha)^3}E_3 + \frac{\alpha^3(1-N)^3}{(1+\alpha)^4}E_4 +$$

$$\frac{\alpha^4(1-N)^4}{(1+\alpha)^5}E_5 = 0$$

$$(22)\quad \frac{\partial \pi}{\partial AD_2} = \frac{E_2}{(1+\alpha)^2} + \frac{\alpha(1-N)}{(1+\alpha)^3} E_3 + \frac{\alpha^2(1-N)^2}{(1+\alpha)^4} E_4 + \frac{\alpha^3(1-N)^5}{(1+\alpha)^5} E_5 = 0$$

$$(23)\quad \frac{\partial \pi}{\partial AD_3} = \frac{E_3}{(1+\alpha)^3} + \frac{\alpha(1-N)}{(1+\alpha)^4} E_4 + \frac{\alpha^2(1-N)^2}{(1+\alpha)^5} E_5 = 0$$

$$(24)\quad \frac{\partial \pi}{\partial AD_4} = \frac{E_4}{(1+\alpha)^4} + \frac{\alpha(1-N)}{(1+\alpha)^5} E_5 = 0$$

$$(25)\quad \frac{\partial \pi}{\partial AD_5} = \frac{E_5}{(1+\alpha)^5} = 0$$

where:

AD_t = actual amount of accrued expenses prepaid or income postponed in period t

E_t = actual marginal tax rate in period t

α = rate of discount as measured by before-tax income generated from a one dollar increase in net worth

The five unknowns (E_1 through E_5) in these linear equations can easily be solved for in terms of each other.

The use of before-tax rather than after-tax implications could lead to biased results. Before-tax implications do not consider the effect that marginal tax rates in future years have on after-tax income generated in future years because of additional cash deductions taken in an earlier year. Looking at equations 16 through 20 we see this bias could lead to an overstatement of income generated in future years from an additional dollar of additional cash deductions taken this year. The overstatement of income could lead to greater additional cash

deductions being taken than would be the case if after-tax implications were used. It, also, could make the cash method of accounting seem more advantageous than it really is.

Keeping this potential bias in mind, the use of before-tax implications can be justified. First, if no advantage to the cash method of accounting exists, no additional before-tax income will be generated when compared to accrual accounting. The use of before-tax implications will indicate differences although it may overstate them slightly. Second, very little knowledge about the relative advantage of the cash method for different farm types and size classes over a period of time exists. While before-tax implications could over-state advantages of the cash method, it still can be used to compare farm types and sizes for relative advantages because all groups have the same bias.

EMPIRICAL MODEL

Flow Chart

The conceptual model developed in previous chapter presents the procedure for finding the optimal level of cash deductions, and the resulting impact on after-tax income, consumption, change in net worth, and growth rate. The flow chart in Figure 1 summarizes the parameters and interrelationships needed to use this procedure in empirical analysis. The empirical analysis is similar for the cash and the accrual methods of accounting. Therefore, Figure 1 can be used to describe both methods. A step by step discussion of the flow chart will aid in its understanding.

Step 1

Assets (A_t) and liabilities (D_t) are calculated in the same manner for both accounting methods. A_1 is given and A_2 through A_5 can be determined using equation 5 discussed in the previous chapter. D_1 is also given, and D_2 through D_5 can be calculated using equation 6 from the previous chapter.

Step 2

Earned income (B_t) has the same definition for both accounting methods. B_1 is given and B_2 through B_5 can be determined using equation 7 discussed in the previous chapter.

Step 3

Additional cash deductions (AD_t) cannot be taken under the accrual method (i.e., $AD_t = 0$). When the cash method of accounting is used to

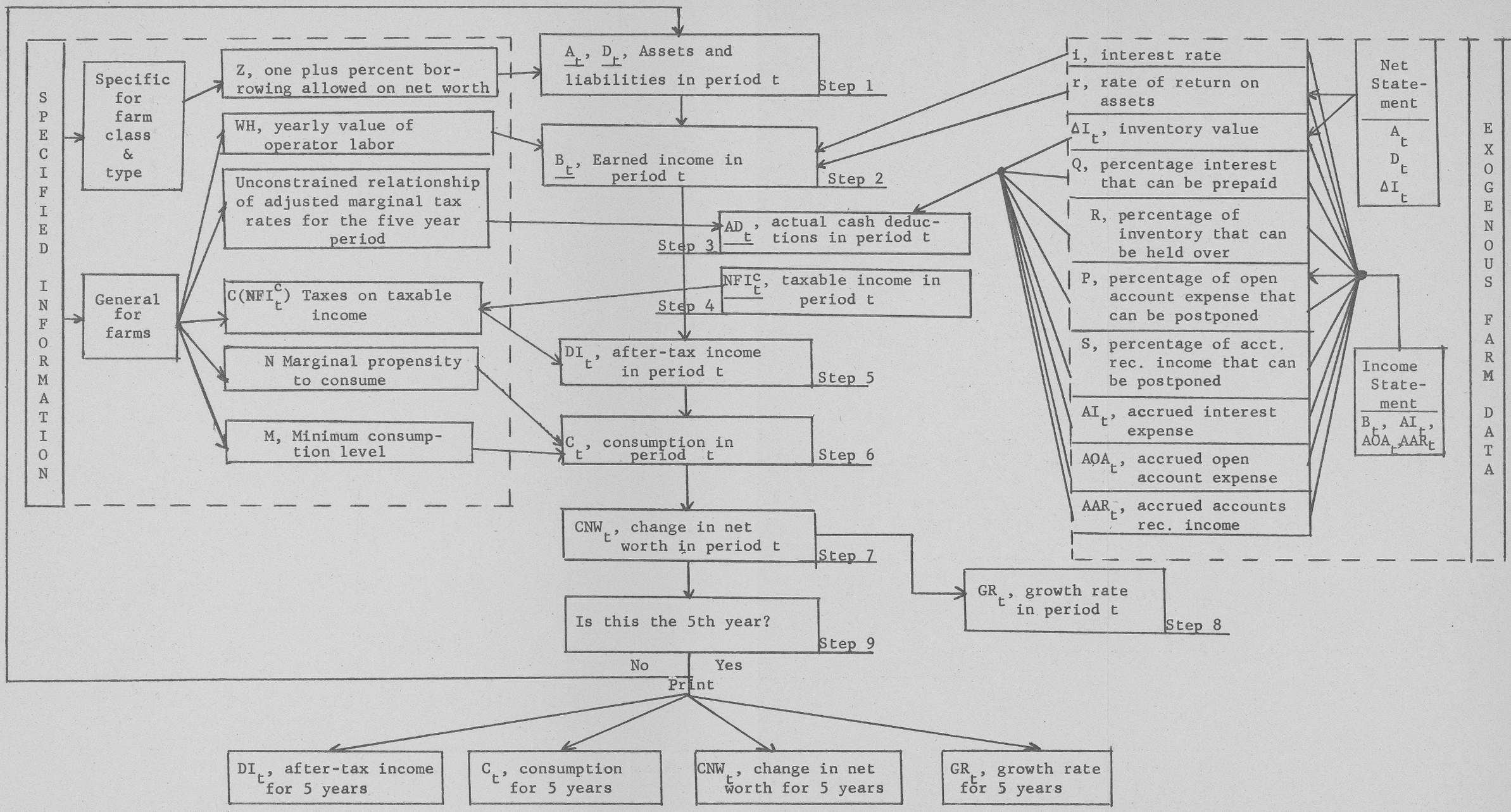

Figure 1. Farm growth flow chart

report taxable income, additional cash deductions may be taken.

The farmer using the cash method and wanting to maximize his total five year after-tax income will manipulate his additional cash deductions (AD_t) each year. These additional cash deductions are taken in such a way that the constrained yearly marginal tax rates, when adjusted for the discount rate and future earnings rate on before-tax income, most closely resemble the optimum unconstrained yearly marginal tax rates with the same adjustments. This process is performed subject to constraints on the maximum yearly amount of additional cash deductions.[1]

The optimal unconstrained relationship of yearly and adjusted marginal tax rates can be determined using equations 12 and 21 through 25. Once AD_1 is specified the marginal tax rate in year one (E_1) can be found using equation 11 and the tax table. The unconstrained marginal tax rates for years two through five can then be determined using E_1 and its adjusted relations to E_2 through E_5.

With AD_1 specified and E_1 determined, the constrained values of E_2 through E_5 amd AD_2 through AD_5 can also be found. The unconstrained value of E_2 dictates the taxable income in year two (NFI_2^c) that is desired. Earned income in year two (B_2) can be calculated. Using equation 11 and these two variables we can solve for the desired AD_2. By evaluating the desired AD_2 in comparison to the maximum AD_2, the actual AD_2 that can be taken is determined. This process is repeated to obtain AD_3 through AD_5.

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[1] See Appendix 1 footnote for a description of these maximum amounts.

The specification of AD_1 is necessary to calculate the proper associated AD_2 through AD_5. To be sure the correct AD_1 is chosen, its value is varied in a simulation model from zero to its maximum. The set of optimal unconstrained adjusted marginal tax rates (calculated using equations 21 through 25 specifies the set of additional cash deductions that maximizes after-tax income for a five year period.

Step 4

Taxable income in any period (NFI_t^c) is the same as earned income (B_t) if the accrual method is used. Under the cash method of accounting it is calculated using equation 11.

Step 5

After-tax income (DI_t) for both accounting methods is found using equation 10. It is assumed a joint tax return is filed.

Step 6

Consumption (C_t) for both accounting methods is calculated using equation 3 discussed in the previous chapter.

Step 7

Change in net worth (CNW_t) is calculated using equation 4 discussed in the previous chapter. This equation is used for both accounting methods.

Step 8

Growth rate (GR_t) is calculated using equation 10b in Appendix 1. This equation is used for both the cash and the accrual methods.

Step 9

If this is the fifth year of the calculation procedure, five year summaries of DI_t (Step 5), C_t (Step 6), CNW_t (Step 7), and GR_t (Step 8) are printed. If it is not the fifth year, (NW_t) is used in calculating the next years assets (A_t) and liabilities (D_t).

Parameter Specification

The specified parameters in Figure 1 must be assigned numerical values to use the analysis procedure in evaluating the impact of the cash and accrual accounting methods for various types and size of farms. These values, and the methods used to derive them are discussed below.

Data for this study comes from 1974 Iowa Farm Business association records. Farms from this data fall into three farm enterprise types. The farm types and their associated farm products are listed in Table 6.

Table 6. Farm type classed according to product sold (8)

Farm type	Product sold
Cash grain	Corn, sorghums, small grains, soybeans, seed beans
Dairy	Dairy products, milk, crea, dairy cattle
Other livestock	Cattle, calves, hogs, sheep, goats, wool

Types of farms in this data source fall into two basic economic classes. The economic classes depend upon the value of agricultural sales. The two classes and associated value of agricultural sales are: Class II--$20,000 to $39,999 and Class 0--$100,000 or more (8).

One plus the percent borrowed on new net worth (Z)

The percent of net worth that can be borrowed varies with the farm size and enterprise type. Financial institutions evaluate a farm's cash-flow statement, debt to equity ratios, and other characteristics to determine how much money it is loaned. Since each farm size and enterprise type differs in these characteristics, the amount of money loaned and subsequently the percent borrowing on net worth varies with farm size and enterprise type. Since Z is one plus this percent, it must also vary with farm size and enterprise type. However, for purposes of this model, Z is assumed to remain constant over the five year period for each size and enterprise type.

Each farm class exists within each farm type for the data analyzed. This means there are six different Z values for the data analyzed. The Z values for each class within each farm type are listed in Table 7.[1]

Table 7. Z value according to farm class and type

Farm class	Cash grain	Farm type dairy	Other livestock
0	1.30	1.55	1.52
II	1.18	1.34	1.32

Yearly value of operator labor (WH)

The yearly value of operator labor is assumed to be constant for all farms over the five year period. W is the hourly wage rate for

[1]See Appendix 2 for a discussion of how these Z values were derived.

operator labor. The average wage paid for farm supervisors in 1974 was $3.80 per hour (9). The average wage paid for crop and livestock labor in 1974 was $2.29 per hour (9). Assuming a farm operator devotes half of his time to supervision, and half to crops and livestock his average wage rate would be $3.03 per hour.

H is the hours worked per year by the farm operator. It is assumed the operator works 40 hours per week for 50 weeks during the year. This gives 2,000 as the hours worked per year by the operator. WH, yearly value of operator labor, is then equal to $6,060.

Taxes ($f(NFI_t^c)$)

The taxes on taxable income are found using equation 26

$$(26) \quad f(NFI_t^c) = a + b(NFI_t^c - c)$$

The parameters a, b and c are found in the tax table assuming a joint tax return if filed. These parameters are summarized in Table 8 (22).

Marginal propensity to consume (N) and minimum consumption level (M)

The marginal propensity to consume (N) and minimum consumption level (M) are determined using linear regression with after-tax income as the independent variable and consumption as the dependent variable. The independent variables were obtained by varying after-tax income from $5,000 to $50,000 in $200 increments. The dependent variables associated

Table 8. Schedule Y joint tax return

NFI_t^c			a	b	c
$ 1,000 <	≤	$ 2,000	$ 140	0.15	$ 1,000
2,000 <	≤	3,000	290	0.16	2,000
3,000 <	≤	4,000	450	0.17	3,000
4,000 <	≤	8,000	620	0.19	4,000
8,000 <	≤	12,000	1,380	0.22	8,000
12,000 <	≤	16,000	2,260	0.25	12,000
16,000 <	≤	20,000	3,260	0.28	16,000
20,000 <	≤	24,000	4,380	0.32	20,000
24,000 <	≤	28,000	5,660	0.36	24,000
28,000 <	≤	32,000	7,100	0.39	28,000
32,000 <	≤	36,000	8,660	0.42	32,000
36,000 <	≤	40,000	10,340	0.45	36,000
40,000 <	≤	44,000	12,140	0.48	40,000
44,000 <	≤	52,000	14,060	0.50	44,000
52,000 <	≤	64,000	18,000	0.53	52,000
64,000 <	≤	76,000	24,420	0.55	64,000
76,000 <	≤	88,000	31,020	0.58	76,000
88,000 <	≤	100,000	37,980	0.60	88,000
100,000 <	≤	120,000	45,180	0.62	100,000
120,000 <	≤	140,000	57,580	0.64	120,000
140,000 <	≤	160,000	70,380	0.66	140,000
160,000 <	≤	180,000	83,580	0.68	160,000

Table 8. (Continued)

NFI_t^c		a	b	c
$180,000 <	≤ $200,000	$ 97,180	0.69	$180,000
200,000 <		111,980	0.70	200,000

with each independent variable were found using equation 27 (23)[1]

$$(27)\quad C_t = 22.96\ P^{.41}\ I_t^{.59}\ S^{.163}$$

P = consumer price ratio in 1974 compared to consumer

I_t = level of after tax income in period t

S = family size

The variable P was assigned the value of 1.6484. Family size (S) was assigned the value 4. The linear regression assigned the value 0.333 to N and $5123.4 to M. These values are assumed to remain constant for all farm sizes and types over the five year period.

[1]Equation 27 cannot be used directly as the consumption function in this analysis because it is non-linear. This non-linearity means the marginal propensity to consume (N) for equation 27 is a function of after-tax income. The five year after-tax profit function (π) in equation 12 discussed in the previous chapter is a function of the marginal propensity to consume (N) which means it is also a function of after-tax income. The partials $\frac{\partial \pi}{\partial AD_1}$ of equation 12 will then also be functions of after-tax income. This gives a simultaneous system because the value for AD_t cannot be determined using the partials $\frac{\partial \pi}{\partial AD_t}$ until after-tax income in period t is known. (Footnote continued on next page.)

Exogenous Farm Data

The data for this study was obtained from summaries of Iowa Farm Business Association records for 1974. For each farm size and type analyzed, summary data was obtained on accrued interest expense in period 1 (AI_1), accrued open account expense in period 1 (AOA_1), accrued accounts receivable in period 1 (AAR_1) and earned income in period 1 (B_1) from the accrual income statement. Assets in period 1 (A_1) liabilities in period 1 (D_1) and inventory value in period 1 (ΔI_1) came from the balance sheet.

The following values for exogenous variables needed in the analysis were obtained from farm data and specified parameters.

$$(28) \quad i = \frac{AD_1}{D_1}$$

$$(29) \quad r = \frac{B_1 - AI_1 - WH}{A_1 - D_1}$$

$$(30) \quad Q = \frac{LIA_1 + IIA_1}{AI_1}$$

LIA_t = long term accrued interest expense

IIA_t = intermediate term accrued interest expense

(Footnote continued from previous page.) The use of a linear consumption function gives the marginal propensity to consume a specific numerical value. This means the partials $\frac{\partial \pi}{\partial AD_t}$ are not a function of after-tax income each period, and the AD_t's can be numerically determined without first knowing the after-tax income each year.

(31) $\alpha = rZ - i(Z-1)$

Other exogenous variables must also be specified or estimated for the farm analyzed. The percentage of inventory that can be held over each year (R) was estimated by determining the inventory holding capacity of the farm. Maximum percentage of open account expense that can be prepaid (P), and maximum percentage of accounts receivable income postponed (S) must be less than or equal to one but greater than zero.[1]

Once the parameters have been specified and all exogenous farm data calculated or specified for the first year, the empirical model becomes functional. The exogenous farm data (i, r, α, Q, R, S and P) are assumed to remain constant over the five year period for each farm. The endogenous data (B_t, A_t, D_t, AOA_t, AI_t, AAR_t and SI_t) are calculated using equations 2, 5 and 6 found in the previous chapter and equations 10d, 10c, 10e and 10f found in Appendix 1. The model was computerized using Fortram WAT5 and solved on an IBM 360-65 computer.

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[1] See page 14, paragraph 1 for explanation of this requirement.

EMPIRICAL COMPARISON OF DIFFERENT ACCOUNTING SYSTEMS

Each of the data sets for the twelve size-type farms was analyzed for a five year period using three different basic accounting methods to report taxable income. First, the accrual method was used. Next, two variations of the cash method were studied. In one variation, maximum yearly additional cash deductions were taken. The second variation included optimum yearly additional cash deductions rather than the maximum.

Results for the twelve sets of data using the three accounting variations are summarized in two categories. First, the business analysis results for the variables after-tax income, consumption, change in net worth, and growth rate are obtained. Then the tax analysis variables--additional cash deductions, taxable income, tax liability, and marginal tax rate--are generated and summarized.

Specific Data and Results for Class 0 Dairy Farm

The data set and results for the Class 0 dairy farm will be used as an example of the data required and results generated with the empirical model in the previous chapter.

Data set

The data set for the Class 0 dairy farm was obtained from 1974 Iowa Farm Business Association records. This data is listed in Table 9. The $69,367.00 value for earned net farm income in Table 9 is the return to total farm assets and operator labor. The asset value, $626,129.00, is composed of items such as land, buildings, livestock, and crop

machinery, dairy breeding cattle, and other miscellaneous assets. The Iowa Farm Business summaries assign dollar values to aggregate assets, so it is not possible to obtain values for specific types of assets.

The liabilities in Table 9 fall into three basic groups, short term, intermediate term, and long term. The short term liabilities are 30 percent of the total liabilities or $18,492.90. The intermediate and long term liabilities make up the remaining 70 percent amounting to $43,150.10.[1]

Table 9 lists 70 percent as the maximum percent of total interest that can be prepaid. This value is equal to the percent of total liabilities that are classified as intermediate or long term in nature.

The maximum percent of open accounts that can be prepaid and accounts receivable that can be postponed is assumed to be 100. The maximum percentage of inventory value that can be held from sale in one year is listed in Table 9 as 50 percent. This 50 percent value was obtained by assuming that all of the grain produced for sale could be held. Also the calves born to the milk cows could be held in inventory one year. However, the milk produced from the operation must be sold after it is obtained. Milk sales accounted for approximately 50 percent of total farm sales.

The accrued interest expense is $4,315 and is calculated as 7.5 percent on liabilities valued at $61,643. The accrued open account expense value in Table 9 is $37,684. Types of open account expense are feed, fertilizer, seed, supply, and miscellaneous purchases. The accrued

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[1]The total asset to total liability ratio is approximately 10 to 1. One the surface this seems high but when current market values are used for land this ratio is not unreasonable.

accounts receivable income of $260 is primarily the result of small amounts of custom work performed. This value is small because large dairy operations use almost all of the available labor in the operation, leaving little for custom work.

The inventory value of $135,004 in Table 9 is composed of young dairy cattle, grain crops, feed, and supplies. Specific dollar values for each group of inventory are not summarized by the Iowa Farm Business Association. The Z and α parameters have been discussed previously.

The accrual accounting method

Table 10 lists the business and tax analysis results for Class 0 dairy farms when the accrual method of accounting is used for tax purposes. The five year total discounted after-tax income is $172,782.70. The five year total consumption is $77,495.44. The total five year increase in net worth in Table 10 is $123,398.42. Change in net worth shows yearly increases during the five year period. The average growth rate over the five years is 0.0403. The growth of the Class 0 dairy farm is positive every year. However, the rate of growth declines each year which is typical for an economic organization in mature stages of development (14).

The tax analysis results in Table 10 aid in understanding the tax implications of the accrual accounting method. When the accrual method is used for tax purposes, no additional cash deductions (prepaid expenses and postponed income) can be declared, so this variable is zero every year in Table 10. The taxable income in year 1 is $69,367. This is exactly equal to earned income in year 1 as given in Table 9. When the

Table 9. 1974 Iowa Farm Business Association data for Class 0 dairy farms

Farm data	Value	Farm data	Value
Earned net farm income (NFI_1^a)	$ 69,367	Accrued interest (AI_1)	$ 4,315
Assets (A_1)	626,129	Accrued open account expense (ACA_1)	37,684
Liabilities (D_1)	61,643	Accrued accounts receivable (AAR_1)	260
Maximum percent of interest prepaid (Q_1)	70%	Inventory Value (ΔI_1)	135,004
Maximum percent of open accounts prepaid (Q_2)	100%	One plus percent borrowed on net worth (Z)	1.55
Maximum percent of accounts receivable postponed (Q_3)	100%	Income generated from $1 new net worth ($\alpha$)	0.12
Maximum percent of inventory held over (Q_4)	50%		

Table 10. Class 0 dairy farm: accrual method for tax purposes

	Decision variable[a]	Year 1	2	3	4	5
Business	After-tax income	$38,536.35	$36,403.48	$34,383.37	$32,662.11	$30,807.39
Analysis	Consumption	$17,541.04	$16,438.47	$15,400.90	$14,519.79	$13,595.24
Results	Change in net worth	$22,874.77	$23,759.38	$24,678.20	$25,581.37	$26,504.70
	Growth rate	0.0405	0.0405	0.404	0.402	0.401
Tax	Additional cash deductions	$ 0	$ 0	$ 0	$ 0	$ 0
Analysis	Taxable income	$69,367.00	$72,315.56	$75,378.15	$78,559.18	$81,856.63
Results	Tax liability	$27,311.85	$28,993.56	$30,677.98	$32,504.32	$34,416.84
	Actual marginal tax rate	0.55	0.55	0.55	0.58	0.58

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

accrual method of accounting is used for tax purposes, earned income will always equal taxable income because additional cash deductions cannot be declared.[1] The yearly tax liability and the yearly tax rate vary directly with the taxable income. When taxable income (i.e., earned income) increases, so do the tax liability and marginal tax rate.

The cash accounting method with maximum additional cash deductions

The tax and business analysis results when the cash method of accounting with maximum yearly additional cash deductions is used for tax purposes are summarized in Table 11. Under this accounting method the five year total discounted after-tax income is $211,922.28. After-tax income is at its high point in year 1 with a discounted value of $63,637.29. This high value is possible because the maximum additional cash deductions ($109,816.54) were declared in year one. As was discussed in second chapter, larger additional cash deductions result in a lower tax liability in year 1 ($0.00) which in turn leads to the high after-tax income in year 1.

Specifically, the cash method with maximum yearly additional cash deductions has a $27,371.85 greater after-tax income the first year than the accrual method. This additional income generates $18,248.81 in additional assets in year 2. These additional assets generate $1,058.69 additional after-tax income in year 2. This dollar value added to the $4,400.00 income saved from taxes because the maximum additional cash deductions were declared in year 2 gives the total higher income figure for the cash method of $5,458.69.

[1]See equation 11 in the second chapter for a more analytical understanding.

In years 2 through 5, after-tax income follows a pattern similar to the one established for after-tax income in Table 10. However, the cash method with maximum additional cash deductions has higher yearly after-tax income values in years 2 through 5 than does the accrual method.

The total consumption for the five years with maximum deduction cash accounting is $90,540.66 (Table 11). Consumption is at its high in year 1. Again, consumption in years 2 through 5 is higher than when the accrual method is used for tax purposes. For example, the additional $5,458.69 of after-tax income in year 2 under the cash method with maximum deductions allows an additional $1,819.38 to be consumed in that year. The same process can be used to explain the higher consumption values for years 3 through 5 with the cash system.

The total change in net worth for the five year period is $154,190.65. Yearly changes in net worth follow the same pattern as after-tax income and consumption. The five year total growth rate in Table 11 is 0.2477. After the first year, the yearly growth rates follow a pattern similar to that under the accrual accounting method shown in Table 10.

The tax analysis results listed in Table 11 help explain why the business analysis results are higher with the maximum deduction-cash compared to the accrual accounting system. When maximum additional cash deductions are taken each year, the yearly value of these deductions is determined using equation 10a in Appendix 1, and the appropriate information from the data set. In this situation, all possible expenses are prepaid and all possible income is postponed. For the Class 0 dairy farms the maximum value of these deductions for the first year is $109,816.54. Maximum additional cash deductions in years 2 through 5

Table 11. Class 0 dairy farm: cash method, maximum deductions

	Decision variable[a]	Year 1	2	3	4	5
Business	After-tax income	$63,637.29	$40,990.41	$37,614.96	$35,808.98	$33,870.64
Analysis	Consumption	$25,910.51	$17,967.29	$16,477.99	$15,568.65	$14,616.22
Results	Change in net worth	$41,123.58	$27,398.68	$27,479.17	$28,539.67	$29,649.55
	Growth rate	0.0729	0.0452	0.0434	0.0432	0.0430
Tax	Additional cash deductions	$109,816.54	$ 8,000.00	$ 5,330.21	$ 5,345.87	$ 5,552.18
Analysis	Taxable income	($40,449.54)	$66,667.55	$72,869.33	$76,395.74	$79,868.20
Results	Tax liability	$ 0	$25,887.16	$29,298.13	$31,244.53	$33,263.56
	Actual marginal tax rate	0.00	0.55	0.55	0.58	0.58

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

are much smaller ranging from $8,000 in year 2 to $5,330.21 in year 3. Because most expenses are prepaid and income postponed in year 1, the maximum additional cash deductions in years 2 through 5 reflect only yearly increases in these expenses and income.[1]

Taxable income in Table 11 for year 1 is negative (-$40,449.54) because maximum additional cash deductions exceed earned income in year 1. Taxable income in years 2 through 5 is positive with yearly increases similar to those found in Table 10 for the accrual accounting method.

The tax liability and marginal tax rate are equal to 0 for year 1 because taxable income in year 1 is not positive. If taxable income was equated to zero in year 1, $40,449.54 of additional first year cash deductions could have been used to reduce taxable income in future years. Tax liability and marginal tax rate in years 2 through 5 show a direct relationship to the taxable income in years 2 through 5.

In summary when comparing the cash method of accounting using maximum deductions to the accrual accounting method, the business analysis variables for both methods show similar trends after year 1. The variables for the maximum deductions-cash method are higher than the accrual method because first year additional cash deductions assist in generating increases in earned income in years 2 through 5. The main difference between the two methods results from the opportunity to take the maximum additional cash deductions in the first year.

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[1] An example of the maximum deduction for accrued interest will illustrate this point. Assume: $100 accrued cash interest with 10 percent annual growth rate. The maximum additional cash deduction in year 1 is $110, a total of $210 cash interest is paid in year 1 but only $110 is prepayment. In year 2 the additional cash deduction is $10. One hundred ten dollars is the actual accrued interest for year 2. A total of $120 of cash interest is paid in year 2, meaning a $10 additional cash deduction.

The cash accounting method with optimum additional cash deductions

The business and tax analysis results using the cash method with optimum additional cash deductions for tax purposes are summarized in Table 12. Total discounted five year after-tax income is $245,512.67. The discounted after-tax income for year 1 is $57,969.09. This value is $19,442.74 higher than the discounted first year figure for the accrual method listed in Table 10, and $5,668.2 lower than the discounted first year figure for the cash method maximum yearly deductions in Table 11. Some (but not all) of the additional cash deductions are taken in Table 12, so the after-tax figure is higher than with the accrual method (Table 10). The deductions in Table 12 are less than the maximum amount taken in Table 11, so the cash method-optimum deductions has a lower after-tax income in year 1 than the cash method-maximum deductions.

After-tax income values for years 2, 3 and 4 in Table 12 are higher than the same values in Tables 10 and 11 because optimum additional cash deductions are taken in Table 12. The cash method with optimum additional cash deductions makes use of part of the first year cash deductions in years 2 and 3 rather than using them all the first year as does the cash method with maximum yearly additional cash deductions.

The discounted after-tax income in Table 12 for year five is $2,506.00 higher than for the accrual method. The cash method-optimum deductions has $60,152.89 more net worth in year 5 than the accrual method. This net worth generates increased after-tax income in year 5. Also, there are $1,278.42 in additional cash deductions under the cash method. This generates an additional $767.33 of after-tax income.

Table 12. Class 0 dairy farm: cash method, optimum deductions

	Decision variable[a]	Year 1	2	3	4	5
Business	After-tax income	$57,969.09	$56,331.08	$52,995.93	$44,903.18	$33,313.39
Analysis	Consumption	$24,021.30	$23,080.34	$20,480.98	$18,599.75	$14,430.49
Results	Change in net worth	$37,004.35	$39,570.08	$40,810.54	$37,088.88	$29,077.46
	Growth rate	0.0656	0.0658	0.0637	0.0544	0.0404
Tax	Additional cash deductions	$43,926.62	$46,136.87	$43,237.46	$26,606.08	$ 1,278.72
Analysis	Taxable income	$25,440.38	$28,000.00	$36,000.00	$57,891.88	$88,000.00
Results	Tax liability	$ 6,178.54	$ 7,100.00	$10,340.00	$21,182.70	$37,980.00
	Actual marginal tax rate	0.36	0.39	0.45	0.53	0.58

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

The discounted after-tax income in Table 12 for year 5 is $557.25 lower than fifth year income using maximum cash deductions (Table 11). The maximum additional cash deductions are declared in Table 11 for year 5. This is not the case in Table 12. The optimizing conditions used to find optimum yearly additional cash deductions are part of a set for an infinite length of time. Consequently, maximum deductions are not taken in year 5 even though it is the last year analyzed. Because of this $4,273.46 in earned income is taxed that would not have been if maximum deductions were taken the last year.

Five year total discounted consumption, change in net worth, and average growth rate in Table 12 are $100,612.86, $183,551.31, and 0.0580, respectively. The trend over time for these variables follows a pattern similar to after-tax income.

The tax analysis results in Table 12 can be used to explain the income and business growth implications of the cash method-optimum deductions system. The additional cash deductions are not taken in the maximum amount every year as was the case in Table 11. The yearly optimum additional cash deductions for the Class 0 dairy farm are selected in the manner indicated in Step 3 of the flow chart discussed in the previous chapter. These optimal deductions are determined by the set of yearly adjusted marginal tax rates that most closely resemble the unconstrained profit maximizing set of tax rates.

The unconstrained profit maximizing set of marginal tax rates for the Class 0 dairy farm for years 1 through 5 is: year 1 = 0.36, year 2 = 0.40, year 3 = 0.45, year 4 = 0.51, year 5 = 0.61. The constrained set of marginal tax rates specified by the optimal additional cash deductions

that most closely resembles this unconstrained set, and is consistent with the tax structure is: year 1 = 0.36, year 2 = 0.39, year 3 = 0.45, year 4 = 0.53, year 5 = 0.60.

In years 2 and 5 the constrained marginal tax rates are lower than the unconstrained marginal tax rates. The tax structure does not contain the marginal tax rates 0.40 and 0.61 found in the unconstrained set for years 2 and 5. The marginal tax rates in the tax structure most closely resembling these are 0.39 and 0.60. These are the marginal tax rates found in the constrained set for years 2 and 5.

In year 4, the constrained marginal tax rate, 0.53. is higher than the unconstrained marginal tax rate 0.51. The maximum additional cash deductions that can be taken equals $26,606.08 in year 4. When this maximum amount is taken, the constrained marginal tax rate is 0.53. This 0.53 rate most closely resembles the unconstrained rate of 0.51 given the maximum amount of additional cash deductions that can be taken in that year.

Taxable income for year 1 in Table 12 is $25,440.38. This is $65,889.92 higher than the same figure in Table 11, but $43,926.62 lower than in Table 10. Taxable income in years 2 through 5 follow a similar pattern as do the tax liability and marginal tax rate because they are directly related to taxable income.

Accounting methods compared

The empirical model in the previous chapter was developed to compare the affects of different accounting methods on business analysis variables.

Table 13 summarizes the five year differences between accounting methods for Class 0 dairy farms.

Table 13. Five year business analysis totals for each accounting method Class 0 dairy farm

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$172,782.70	$211,922.28	$245,512.67
Consumption	$ 77,495.44	$ 90,540.66	$100,612.86
Change in net worth	$123,398.42	$154,190.65	$183,551.31
Average growth rate	0.0403	0.0495	0.0580

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Table 13 shows that the cash method with optimum deductions has a $33,590.39 advantage in the five year total after-tax income over the cash method with maximum deductions. Its advantage over the accrual method is $72,729.97. The same conclusion can be drawn for five year total consumption. The advantage of the cash method with optimum deductions over the cash method with maximum deductions and the accrual method is $10,072.20 and $23,117.42 respectively.

The advantage of optimum deductions compared to maximum deductions and accrual accounting is $29,360.66 and $60,152.89. With respect to five year average growth rate the advantage for the cash method with optimum deductions is 0.0085 and 0.0177 compared to the maximum deductions and accrual systems respectively.

Table 13 points out the advantage of both variations of the cash method over the accural method of accounting. To find the relative advantage of these different accounting systems, the dollar amount of each variable listed in Table 13 for the cash system is divided by the dollar amount for the accrual method. These ratios are listed in Table 14. The percent advantage that the two variations of the cash

Table 14. Relative advantage of cash method of accounting methods over the accrual accounting method

Decision variable	Cash method maximum deductions	Cash method optimum deductions
After-tax income	1.227	1.381
Consumption	1.168	1.303
Change in net worth	1.250	1.487
Growth rate	1.228	1.439

accounting method have over the accrual method can be determined as the value in Table 14 minus one multiplied by 100. For example, the cash method with optimum deductions has a 38.1 percent advantage over the accrual method when after-tax income is considered.

The results summarized in Tables 13 and 14 show that a Class 0 dairy farm increases five year totals for the business analysis variables significantly if it uses the cash method with optimum deductions for tax purposes.

Results for Other Farm Sizes and Types

The results summarized for Class 0 dairy farms in Tables 13 and 14 provide a base for analyzing the affects of different accounting methods for other types of farms. Tables 15 through 23 are similar to Table 13 in that they summarize five year total dollar values for each farm size class and enterprise type studied. Table 15 indicates that the cash method with optimum deductions allows a Class II grain farm to generate $14,311.16 more discounted after-tax income over a five year period than if the accrual accounting method were used. The optimum deduction variation has a $6,121.91 advantage over the maximum deduction variation in Table 15 for after-tax income.

Table 15. Five year business analysis totals for Class II grain farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$64,359.62	$72,548.87	$78,670.78
Consumption	$41,350.30	$44,087.52	$46,127.95
Change in net worth	$29,916.15	$36,610.13	$43,236.58
Average growth rate	0.058	0.069	0.080

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Consumption (discounted) and change in net worth over a five year period can be increased by $4,777.65 and $13,320.43, respectively, if the Class II grain farm uses the cash method with optimum yearly

additional cash deductions rather than the accrual method. If the Class II grain farm uses the cash method with optimum deductions, its five year average growth rate is 0.080. This growth rate is 0.022 higher than that attained when the accrual accounting method is used, and 0.011 greater than when using the cash method with maximum additional cash deductions.

Table 16 shows that the advantage of cash accounting with optimal deductions over the accrual method is $192,259.01 in discounted after-tax income for Class 0 grain farms. The cash method with optimum deductions has a $101,035.76 advantage over the maximum deductions variation when five year total after-tax income is considered.

Table 16. Five year business analysis totals for Class 0 grain farms

Decision variables[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$244,534.59	$335,757.84	$436,793.60
Consumption	$101,410.36	$131,815.06	$165,490.28
Change in net worth	$185,504.82	$259,135.44	$348,277.65
Average growth rate	0.052	0.070	0.091

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Table 17 summarizes the advantage of the cash accounting method with optimum yearly additional deductions for the Class II hog and beef feeding farms. This type of accounting provides a $3,677.49 advantage over the

accrual method when five year total discounted consumption is considered. The cash method with optimum additional cash deductions has a $2,325.19 advantage in five year total discounted consumption when compared to the maximum deduction variation.

Table 17. Five year business analysis totals for Class II hog and beef feeding farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$48,479.11	$52,536.44	$59,512,71
Consumption	$36,065.06	$37,417.36	$39,742.55
Change in net worth	$16,039.53	$19,187.13	$25,542.02
Average growth rate	0.016	0.019	0.025

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

The advantage in consumption for Class 0 hog and beef feeding farms is $19,508.48 when the cash method with optimum deductions is compared to the accrual method (Table 18). The advantage over the cash method-maximum deductions is shown in Table 18 as $11,287.57.

Five year total after-tax income for the Class II dairy farm is $43,169.20 when the cash accounting method with optimum deductions is used (Table 19). This value is $7,874.72 higher than the five year total figure in Table 19 for the accrual method. The optimum additional deductions variation of the cash method has a $5,781.11 advantage over

the maximum yearly deductions variation for Class II dairy farms when discounted after-tax income is considered.

Table 18. Five year business analysis totals for Class 0 hog and beef feeding farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$125,377.67	$150,042.85	$183,908.93
Consumption	$61,695.35	$69,916.26	$81,203.83
Change in net worth	$82,239.12	$101,894.05	$132,835.90
Average growth rate	0.024	0.030	0.038

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Table 19. Five year business analysis totals for Class II dairy farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$35,294.48	$37,388.09	$43,169.20
Consumption	$31,670.60	$32,367.68	$34,292.70
Change in net worth	$ 4,670.03	$ 6,221,49	$11,423.29
Average growth rate	0.004	0.005	0.010

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

From Table 20 it can be seen that the Class 0 cow-calf farm will generate $22,197.23 more net worth over a five year period if it uses the cash method with optimum deductions rather than the accrual accounting method. The advantage in net worth accumulation is $13,424.49 if the cash method-optimum deductions is used compared to the cash method with maximum yearly cash deductions.

Table 20. Five year business analysis totals for Class 0 beef cow-calf farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$100,621.40	$112,955.85	$127,294.38
Consumption	$53,444.09	$57,555.16	$62,334.18
Change in net worth	$60,932.79	$70,425.53	$83,850.02
Average growth rate	0.025	0.029	0.034

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Table 21 indicates that the five year average growth rate of Class 0 cattle feeding farms is 1.4 percent when the accrual accounting method is used. If the cash accounting method with optimum yearly deductions is used, the cattle feeding farm can increase its five year average growth rate to 2.1 percent. This 2.1 percent figure is 0.5 percent greater than the five year growth rate generated when the cash method with maximum yearly deductions is used.

Table 21. Five year business analysis totals for Class 0 cattle feeding farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$90,463.65	$101,419.54	$123,991.76
Consumption	$50,058.50	$53,710.10	$61,233.44
Change in net worth	$52,090.38	$60,579.07	$80,979.64
Average growth rate	0.014	0.016	0.021

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Class II hog feeding farms generate $111,141.01 in discounted after-tax income over the five year period when the cash accounting method with optimum yearly deductions is used (Table 22). This is $23,110.69 greater than the five year discounted total after-tax income figure for the accrual accounting method. The cash method with optimum deductions generates $10,840.30 more discounted after-tax income in five years than the cash method with maximum yearly deductions.

Table 23 shows that the Class 0 hog feeding farm can generate $88,333.80 more discounted after-tax income over a five year period if the cash accounting method with optimum deductions is used rather than the accrual method. There is a $12,808.96 advantage for the cash method-optimum deductions over the cash method-maximum deductions when total discounted five year after tax income is considered.

Table 22. Five year business analysis totals for Class II hog feeding farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$88,030.32	$100,300.71	$111,141.01
Consumption	$49,207.54	$53,337.20	$56,945.96
Change in net worth	$50,312.23	$60,338.36	$70,373.48
Average growth rate	0.057	0.067	0.077

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Table 23. Five year business analysis totals for Class 0 hog feeding farms

Decision variable[a]	Accrual method	Cash method maximum deductions	Cash method optimum deductions
After-tax income	$243,859.59	$319,384.43	$332,193.39
Consumption	$101,185.37	$126,357.82	$130,626.80
Change in net worth	$185,156.77	$245,000.92	$254,928.18
Average growth rate	0.057	0.073	0.076

[a]Decision variables, after-tax income and consumption are discounted using a 9 percent discount rate.

Tables 15 through 23 show that for all farm sizes and types, the cash method of accounting with optimum yearly deductions is preferable to the other two accounting systems. This method of accounting produces

more five year total dollars for the business analysis variables of after-tax income, consumption, and change in net worth. It also results in a more rapid growth rate.

Farm Size and Enterprise Type Comparison

Table 14 summarized the relative advantage of the cash method with optimum deductions compared to accrual accounting for the Class 0 dairy farms. Table 24 below summarizes this relative advantage for all farm sizes and enterprise types.

Farm size

Table 24 can be used to determine which farm size can take the most advantage of the cash method with optimum additional deductions. When the business variable after-tax income (discounted) is considered, the most advantageous farm size for each farm type can be found by subtracting the Class II value in Table 24 from the Class 0 value. The resulting values are summarized in Table 25.

Table 25 indicates that larger farms in each farm type can take more advantage of the cash method with optimum deductions compared to their smaller counterparts when after-tax income is considered. One major reason for this is that larger farms have more earned income and subsequently higher marginal tax rates. One dollar in additional cash deductions saves more income from taxes when the marginal tax rate is higher.[1]

[1] An example of this will aid understanding. If a Class 0 farm is in a 50 percent marginal tax rate, one dollar of additional cash deductions will save 50¢ from taxes. If a Class II farm has a 14 percent marginal tax rate this same dollar in additional cash deductions saves only 14¢ from taxes.

Table 24. Relative advantage of cash method, optimum deductions for each farm size and type compared to accrual accounting

Size class of farm	After tax income DI_t		Consumption C_t		Change in net worth CNW_t		Growth rate GR_t	
	II	0	II	0	II	0	II	0
Grain farm	1.222	1.786	1.116	1.632	1.445	1.877	1.374	1.750
Hog and beef feeding farm	1.228	1.467	1.102	1.316	1.592	1.615	1.562	1.583
Dairy farm	1.223	1.381	1.083	1.303	2.443	1.487	2.500	1.439
Beef cow-calf farm	--[a]	1.265	--[a]	1.166	--[a]	1.376	--[a]	1.356
Beef feeding farm	--[a]	1.371	--[a]	1.223	--[a]	1.555	--[a]	1.500
Hog feeding farm	1.263	1.362	1.157	1.291	1.399	1.377	1.33	1.350

[a]Ratios for size II farms cannot be determined because earned income in year 1 (B_1) was negative. The empirical model assumes prices and other factors constant so earned income every year (B_1) would be negative. With negative income the cash method of accounting cannot be used to adjust taxable income (i.e., no ratios can be calculated).

Table 25. Most advantageous farm size for after-tax income when using cash method-optimum deductions

Enterprise type	Size class	Amount of advantage
Grain farm	0	56.4%
Hog and beef feeding farm	0	23.9%
Dairy farm	0	15.8%
Beef cow-calf farm	0	cannot be determined
Beef feeding farm	0	cannot be determined
Hog feeding farm	0	9.9%

A similar conclusion can be drawn about farm size and the advantage of the cash method-optimum deductions when the remaining business variables-consumption, change in net worth, and growth rate--are studied since thes variables are directly related to after-tax income. However, two exceptions to the above generalization are the net worth and growth rate for hog feeding and dairy farms. These enterprise types show more relative advantage to the Class II farms. One possible explanation for this is that hog feeding and dairy farms have such small after-tax income that most of it is consumed by the required minimum consumption level (M). In this situation a small increase in after-tax income results in a large relative increase in net worth and growth rate.[1]

[1]Change in net worth is defined as: $CNW_t = 0.667\ (DI_t) - \$5{,}124.00$, 0.667 = marginal propensity to consume, CNW_t = change in net worth in period t, DI_t = after-tax income in period t, \$5,124 = minimum consumption level. For change in net worth (footnote continued on following page)

Enterprise type

The enterprise type which can obtain the most advantage from cash accounting can be determined from Table 25 by looking at the column for each farm size and for each business variable. For after-tax income, large sized grain farms make more advantageous use of the cash method with optimum deductions than do other large sized enterprise types. The Class 0 enterprise types listed in order of most advantageous to least advantageous use of cash-optimal deduction accounting when after-tax income is considered are: (1) grain farm, (2) hog and beef feeding farm, (3) beef feeding farm, (4) dairy farm, (5) hog feeding farm, and (6) beef cow-calf farm.

A major explanation for this order is the difference in the amount of additional cash deductions that can be declared. Grain farms have the potential for much higher cash deductions because all production of grain can be held from sale. In contrast, while the beef cow-calf farm can also hold all of its production from sale, it has a much lower value of production than does this grain farm. A similar conclusion can be drawn for Class 0 farms when the remaining business variables consumption, change in net worth, and growth rate are evaluated.

The same general order of enterprise types exists for Class II farms when all business variables are considered. However, the differences between enterprise types are not as great as with Class 0 farms because the taxable income is lower for Class II farms.

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[1](footnote continued from previous page) in period t to equal 0, after-tax income in period t (DI_t) would have to equal $7,682.16. If after-tax income in period t equals $7,683.16, change in net worth equals $0.667. If the cash method allows one additional dollar of after-tax income of $7,684.16 change in net worth becomes $1.33. The $1.33 value has double the relative advantage of $0.667 while it represents only $0.667 real increase.

SUMMARY AND CONCLUSIONS

Summary

This study addressed itself to two problems. First, how does a farmer declare additional cash deductions so he maximizes after-tax income over a multi-year period? Next, how much better off financially will this farmer be if he uses the cash accounting method and maximizes multi-year after-tax income by adjusting additional cash deductions?

To aid in understanding these questions, a conceptual model was developed. First, the cash and accrual accounting methods were described from a legal and institutional standpoint. This description was used as a foundation to build the conceptual model.

A basic equation for accrued before-tax income was the first building block on this foundation. This equation equated before-tax income to the net rate of return on assets times the asset value minus the average interest rate times the value of liabilities plus the yearly value of operator labor.

Next the interperiod relationship of accrued before-tax income was developed. All before-tax income in a given year is related to previous year's before-tax income through:

1. how much previous income is taxed;
2. how much previous income is consumed;
3. how much previous income goes to equity;
4. what net rate of return is generated on new equity.

Taxable income is then defined as accrued before-tax income minus additional cash deductions. Additional cash deductions are:

1. prepaid interest expense;
2. prepaid open account expense;
3. postponed accounts receivable income;
4. inventory held from sale.

When the tax liability, determined from the amount of taxable income, is subtracted from accrued before-tax income, after-tax income is obtained.

The multiperiod relationship of after-tax income was developed using the relationship of accrued before-tax income, the definition of taxable income, and the tax liability. One of the problems under study was how to maximize multiperiod after-tax income by adjusting the additional cash deductions component of taxable income. Calculus was used to conceptually demonstrate how this could be done.

Using parameters defined and techniques described in the conceptual model, an empirical model was developed. The defined parameters were numerically specified and the farm data necessary for analysis was spelled out. This empirical model allowed data from farms of different sizes and enterprise types to be used to measure the financial effects and tax implications of different accounting methods. The financial affects measured were after-tax income, consumption, change in net worth, and growth rate. Taxable income, tax liability, and actual marginal tax rate were the tax implications considered.

The empirical model was used to analyze the farms in economic size Classes II and 0. Enterprise types analyzed were cash grain, hog and

beef feeding, dairy, beef cow-calf, beef feeding, and hog feeding. Each farm size within each enterprise class was analyzed giving a total of twelve sets of data.

Data for each set of the twelve farm types was obtained from Iowa Farm Business Association records for 1974. The data were state averages for each farm class and enterprise type. The empirical model was computerized using an IBM 360-65 computer and Fortran WAT5 language.

The results obtained from the analysis indicate that farms using the cash method of accounting and declaring additional cash deductions in an optimizing manner can improve their financial position over a five year period compared to using the accrual accounting method. The Class II dairy farm can increase its five year total after-tax income by $7,874.72 if it uses the cash accounting method rather than the accrual. The Class 0 grain farm using the cash accounting method increases five year after-tax income by $192,259.01. Larger (Class 0) farms within each enterprise type obtain more relative advantage than do their smaller (Class II) counterparts. For Class II grain farms the cash accounting method with optimum additional cash deductions has a relative advantage of 1.22 compared to the accrual method when after-tax income is considered. This advantage increases to 1.79 when larger (Class 0) grain farms are considered. One possible explanation for this result is larger farms have higher earned incomes, and subsequently higher marginal tax rates than do smaller farms. One dollar of additional cash deductions saves more earned income from taxes for the larger farms than the smaller farms because they have a higher marginal tax rate.

The farm enterprise type that obtained the most relative advantage of the cash method with optimum declaration of additional cash deductions was also determined. When large (Class 0) farms are analyzed, the cash grain enterprise type obtains the most relative advantage. Its relative advantage is 33 percent greater than any other Class 0 enterprise type. Possible explanations for this result are:

1. Cash grain farms can hold all their grain inventory from sale. This greatly reduces the income reported for tax purposes.
2. The prices for grain in 1974 were high. This gives the inventory a larger value and would put the cash grain farm in a high marginal tax bracket if sold.

When enterprise types within the smaller (Class II) farm sizes were compared, no enterprise type has a real relative advantage. Smaller farms have lower marginal tax rates. These lower marginal tax rates tend to eliminate any relative advantage to a particular enterprise type.

Conclusions

The results from this study indicate that all farms can gain financial advantages if the cash accounting method with optimum additional cash deductions is used rather than the accrual method. However, farms that have high earned income, and those that can hold a high percentage of inventory from sale can make more advantageous use of this accounting method than those who do not. This conclusion was obtained using 1974 data for Iowa farms. The implications can be extended to other states for other years.

Areas for Further Study

The empirical model used in this analysis assumed that prices for products and inputs remained constant over the five year period. A study including price variability would be beneficial. It could be used to examine the increased potential (if any) for the cash accounting method. It is generally felt that the cash method has even more advantage when product prices vary (16).

The five partial derivatives of the multiperiod after-tax income equation were nonlinear when developed in the conceptual model for maximizing five year after-tax income. These derivatives were made linear for empirical analysis. This introduced potential bias into the results. It could lead to over-statement of the advantage of the cash accounting method because before-tax rather than after-tax implications are considered when linear partial derivatives are used in the maximization process.

Accounting methods are only a small area of tax management. A study comparing different inventory valuation methods would be helpful. Perhaps one method could be shown more beneficial from a tax standpoint. This would be helpful to farmers when making tax management decisions.

An additional study is needed in the area of depreciation methods. A study showing the tax implications of different depreciation methods would be beneficial to farmers. Farmers have great amounts of money invested in depreciable assets, and could gain from a study of this nature.

Many people feel the cash accounting method is most advantageous when product prices are high. They say the cash method allows the farmer in

effect to average his income over a multi-year period (16). A study comparing actual income averaging to the income averaging affect of the cash accounting method would be helpful to farmers.

Finally, farmers can report income on a calendar year or fiscal year basis. Because the farmer generates income seasonally, perhaps different tax basis would be more beneficial to different types and sizes of farms. A study in this area could point out this benefit if it exists.

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APPENDIX I

When the variable AD_t is expanded it shows the accrued expenses that are prepaid, and the accrued income that is postponed. It also shows the inter-year relationship of the AD_t's.

$$(10a)\quad AD_t = K_t[(Q)(AI_t) - (K_{t-1})\,Q(AI_{t-1})] + K_t[(P)(AOA_t) - (K_{t-1})\,P(AOA_{t-1})] + K_t[(S)(AAR_t) - (K_{t-1})\,S(AAR_{t-1})] + K_t[(R)(\Delta I_t) - (K_{t-1})\,R(\Delta I_{t-1})]$$

K_t = percentage of maximum additional cash deductions taken in period t[1]

Q = maximum percentage of accrued interest that can be prepaid in a given year

AI_t = accrued interest expense in period t

$(Q)(AI_t)$ = maximum accrued interest that can be prepaid in period t if no interest prepaid in prepaid in period t-1

$(K_{t-1})\,Q(AI_{t-1})$ = actual accrued interest prepaid in period t-1

P = maximum percentage of accrued open account expense that can be prepaid in a given year

AOA_t = accrued open account expense in period t

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[1] If the accrual method of accounting is used K_t equals 0 (i.e., AD_t equals zero). If K_t equals 1 the maximum additional cash deductions have been taken and equal:

$$MD_t = [(Q)(AI_t) - (K_{t-1})\,Q(AI_{t-1})] + [(P)(ADA_t) - (K_{t-1})\,P(AOA_{t-1})] + [(S)(AAR_t) - (K_{t-1})\,S(AAR_{t-1})] + [(R)\,\Delta I_t - (K_{t-1})\,R(\Delta I_{t-1})].$$

$(P)(AOA_t)$ = maximum accrued open account expense that can be prepaid in period t if no open account expense was prepaid in period (t-1)

$(K)(P)(AOA_{t-1})$ = actual accrued, open account expense prepaid in period (t-1)

S = maximum percentage of accrued accounts receivable income that can be postponed in a given year

AAR_t = accrued accounts receivable income in period t

$(S)(AAR_t)$ = maximum amount of accrued accounts receivable income that can be postponed in period t if no accounts receivable was postponed in period (t-1)

$(K_{t-1})(S)(AAR_{t-1})$ = actual accrued accounts receivable income postponed in period (t-1)

R = maximum percentage of inventory that can be held over in one year.

ΔI_t = inventory value at end of period t

$R\Delta I_t$ = maximum value of inventory that can be held over in period t

$(K_t)\ R(\Delta I_t)$ = actual amount of inventory value held over in period t

AI_t, AOA_t, AAR_t, and ΔI_t increase yearly by a multiple of the growth rate the previous year.

$$(10b)\quad GR_{t-1} = \frac{(1-N)(B_{t-1}) - f(NFI^c_{t-1}))-M}{A_{t-1} - D_{t-1}}$$

The produce of one plus the growth rate and the value the previous year gives the present value of AI_t, AOA_t, AAR_t, ΔI_t.

$$(10c)\quad (IV)\quad AI_t = (1 + GR_{t-1})(AI_{t-1})$$

(10d) (V) $AOA_t = (1 + GR_{t-1})(AI_{t-1})$

(10e) (VI) $AAR_t = (1 + GR_{t-1})(AAR_{t-1})$

(10f) (VII) $\Delta I_t = (1 + GR_{t-1})(\Delta I_{t-1})$

APPENDIX II

Tometich and Boehlje indicate the average dollars borrowed to average dollars of net worth as a ratio (i.e., average percent of borrowing on net worth) for all farm sizes and farm types in Iowa for 1970 (23). Table 1 summarizes this percentage for Iowa farm types. Percentages for Iowa farm sizes are summarized in Table 2.

Table 26. Average percent borrowing on net worth for farm types in 1970 using Iowa data

Farm type	Percent borrowing on net worth
Cash grain	0.19
Poultry	0.69
Dairy	0.35
Other livestock	0.33
General	0.28
All other	0.38

Table 27. Average percent borrowing on net worth for each farm class in 1970 using data for Iowa

Farm type	Percent borrowing on net worth
0	0.46
I	0.31
II	0.28
III	0.18
IV	0.26
V	0.26
Non-Commercial	0.29

The average percent borrowing on net worth for the seven farm classes is 0.29. If the percent borrowing for each farm class is divided by this average, the resulting ratios indicate the percentage of the average percent borrowing on net worth for each farm type. This information is summarized in Table 3.

If the ratio 1.58 is multiplied by the percent borrowing for each farm type listed in Table 2, the percent borrowing for Class 0 farms within each farm type will result. When 0.96 is used, the percent borrowing on net worth for the Class II farm within each farm type results. When 1.00 is added to these percentages the Z values summarized in Table 7 of the second chapter result.

Table 28. Percent borrowing/average percent borrowing, for each farm class in 1970 using Iowa data

Farm class	Percent borrowing/ average percent borrowing
0	1.58
I	1.06
II	0.96
III	0.62
IV	0.89
V	0.89
Non-commercial	1.00