THE IMPORTANCE OF DEFERRED TAXES
TO CAPITAL INVESTMENT

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CHAPTER I

OVERVIEW

Problem Statement

Capital expenditures are among the most important financial decisions made by farmers. They are complex, conceptually difficult decisions which will effect the well-being of the farm business for an extended period of years. Profitability and the ability to repay financial commitments of the farm business are of considerable interest to agricultural producers and managers, their lenders and those serving them such as agricultural extension personnel and consultants.

The complexity of capital expenditures can be separated into two main interactions. The interactions among the factors specific to the capital expenditure, such as its costs and income, and the interactions of the capital expenditure's specific factors with the financial attributes of the whole business. The two sets of interactions combine to effect the business profit, flexibility, risk and value for long periods of time. Thorough analysis of capital investments requires much information concerning the capital expenditure choices as well as the attributes of the whole operation.

Tax deductions are generally an important factor in capital expenditure decisions. The cost of a capital investment is the total costs of the investment over its life less the value of any tax benefits created by the investment over the same period. It has been determined that tax treatments which permit greater reduction of taxes or reduction in earlier time periods increase agricultural producers' rate of investment in depreciable assets (Hrubovack & Le Blanc, 1985).

Tax treatment on depreciable assets results in immediate and deferred effects on income. Typically, capital investment analysis has included the adjustments to annual cash flows resulting from tax savings due to tax depreciation and expensing. However, tax depreciation permits more rapid expensing of an asset than market forces would typically substantiate. This creates a potential taxable gain due to the asset's fair market value being greater than its tax basis. This potential gain is referred to as deferred tax liability. When the asset is sold or traded the potential gain is realized.

The taxable gain on the sale of the assets adds to assets' cost just as depreciation deductions reduce costs. Deferred taxes related to a depreciable asset are essentially an accrued cost of the asset. The accrual of costs through deferred taxes is beneficial from a cash flow standpoint. The firm receives the depreciation deductions (tax benefits) first and must pay the accrued liability later. However, the accruing of this liability may not be beneficial from an income and equity standpoint in some cases. A significant portion of the asset's total cost can be represented in this contingent liability. Instead of recognizing the asset's cost throughout the its life, the accrued cost (the contingent liability) is only recognized at disposal.

This cost accrual not only affects cost recognition, it affects firms' balance sheets as well. Deferred tax liability reduces the value and liquidity of the firm throughout the life of the asset. Inclusion of tax on gains estimated for only the end of the investment period does not adequately portray the interim effect of deferred taxes on the balance sheet. Unlike balance sheets in most other industries which value assets at the lesser of cost or market value, farm balance sheets typically value assets at market values (Farm Financial Standards Task Force, 1991). The common practice of using market values creates the need to understand the effect of deferred tax liability on the value of the firm and the capital investment decision.

Capital investment decisions often involve how long to maintain the investment. The discounted value of an investment can be dependent on the length of the period it is held. Some capital investment analyses examine different lengths of asset holding periods including the differing realized taxable gain on the asset's disposal resulting from different length holding periods (Kay & Rister, 1976). This allows the firms to select the holding period with the highest profit (lowest cost) and assess how profit (cost) would be affected by a change in planned holding period. However, this type of analysis does not address the deferred tax liability on the balance sheet throughout the investment period (asset life). The most profitable (lowest cost) holding period could create the highest liability to the firm throughout the holding period.

Capital investment decisions can involve choices between tax regulations as well. Like-kind exchange treatment for income tax purposes affects the recognition of deferred taxes at end of an investment's life. Like-kind exchange treatment allows the payment of deferred taxes to be avoided if the asset being sold is replaced with another depreciable asset. The deferred taxes of the replaced asset are required to be realized, but at a later date. The deferred taxes (accrued costs) of the replaced asset remain on the liability side of the balance sheet although the replaced asset has been removed from the asset side of the balance sheet. Like-kind exchange treatment could lead to substantial deferred tax liability on the balance sheet.

Most capital investment analysis focuses strictly on costs and does not consider deferred tax liabilities' effect on the value of the firm or the investment decision. More complete knowledge on the important factors involved in capital investment analysis can be valuable to the individual decision maker. Producers, consultants, lenders and agricultural extension personnel would benefit from knowing the relative importance of deferred tax considerations in capital expenditure decisions. Specifically, how important are these considerations for individual firms having certain financial characteristics and management objectives?

Objectives

General Objective:

Increase information available to decision makers assessing the financial effect of capital investments in depreciable assets on farm businesses.

Specific Objectives:

Determine the importance of considering deferred tax to capital investment decisions from an individual investment analysis perspective.

Determine the importance of considering deferred tax to the capital investment decision given differing financial characteristics of firms.

Plan of Research

The importance of deferred taxes will be addressed from two perspectives. First, in the context of a individual depreciable capital asset and its direct replacements. Next, in the context of a whole-firm analysis focusing on the firm's complete machinery complement of depreciable capital assets. Simulation models will be used to estimate the effect of deferred taxes from both perspectives.

Individual Asset Analysis

The analysis of the individual depreciable capital assets will involve a traditional net present value approach by analyzing the cash flows related to the investment. The calculation will be formulated in terms of net discounted cost as opposed to net present value. This formulation attributes no specific returns to the asset and focuses only on costs.

The net discounted cost calculations will be supplemented by calculating the assets' fair market value (FMV) and tax basis throughout the asset holding period. This allows the value of deferred taxes of be assessed against the asset's FMV over the holding period as well as determine the amount deferred taxes contribute to the investment's total cost. A range of discount and tax rates will be used in the discounted cost calculations to address deferred tax considerations under different financial conditions. Deferred taxes will be specifically addressed in terms of optimal holding periods (length of asset life), asset FMV, and asset net discounted cost.

After deferred taxes are analyzed with respect to a single asset, the effect of deferred taxes on replacement assets will be addressed. Replacements will be analyzed specifically in the context of like-kind exchange treatment. Under this treatment the taxable gain on disposal of a replaced asset is deferred by reducing the tax basis of the replacement asset. This continued reduction in tax basis could have important deferred tax consequences. Specifically, the effects of the reduced basises on replaced assets' costs and the accumulation of deferred tax liability (accrued asset costs) on the balance sheet will be addressed. Also the influence that the length of asset holding period has on a series of assets' accumulated deferred tax liability will be analyzed.

Whole-Firm Analysis

Whole-firm financial analysis involves three aspects: 1)the feasibility of a financial plan in terms of liquidity and repayment capacity or more simply stated cash flow, 2)the risk of the plan in terms of solvency or leverage, and 3)the profitability in terms of income. Stated more simply it involves a balance sheet, income statement and cash flow statement. The whole-firm simulation model combines the cash flow, income, equity, and tax effects of an investment into a yearly, whole-firm financial analysis based on the three financial statements. Balance sheet ratios including the percentage of deferred tax liability relative to assets' FMV are also used to evaluate the whole-firm analysis.

The whole-firm procedures hold an example firm's before-tax income, assets, and liabilities constant to focus on the effects of deferred taxes. The individual assets making up the firm's machinery complement will be replaced at different ages to assess length of holding period's effect on deferred tax liability. Holding periods will be addressed with and without like-kind exchange treatment.

Summary

This research addresses the influence of deferred taxes on investments' cost and firm financial measures. Discounted cash flow analysis along with financial statement measures are utilized to address the relative importance of deferred taxes to differing firms and financial situations. Deferred tax liability is addressed in relation to investment assets' fair market value and costs as well as in relation to the whole firms' financial situations.

The focus of this research is on deferred taxes related to depreciable capital investments. Deferred tax liability can be attributable to current assets such as stored crops. Deferred tax liability can also be attributable to non-current assets such as appreciated land or raised breeding stock. Only deferred tax liability related to depreciable non-current assets is addressed in this research.

CHAPTER II

CONCEPTS AND PREVIOUS RESEARCH

Traditional Net Present Value Analysis

Conventional capital theory and related decision aids evaluate capital investments by analyzing the net present value of cash flows due to the investment decision. Generally net present value models utilize a "partial budgeting" approach by presenting the differential effect of the cash flows from the investment without consideration of the effect of these flows in an entire firm context. The investment's income and expenses are discounted back to time period 0 at a chosen discount rate.

Casler et al., (1988) provide an excellent discussion of the advantages, disadvantages, mechanics and components of several methods of measuring investment return. Their conclusion is the use of discounted (present value of) cash flows is the most appropriate method of investment analysis. Casler provides several examples on applications of discounted cash flow techniques including the incorporation of tax considerations. The example applications provide a review of the basic principles used by many of the authors mentioned below.

Abandonment and Replacement

Abandonment Analysis

In most traditional analysis relating to depreciable capital assets, a holding period or asset life of a determined number of years is assumed. The net discounted cost of the asset is calculated from the cash flows resulting from the asset's acquisition, operating costs, tax effects, and sale. However, research such as Herbst's (1982) illustrates that examining only one holding period of a set length is not always a prudent method of analysis. A range of feasible holding periods should be annualized to determine what length holding period yields the highest annualized net present value or lowest annual net discounted cost to the firm.

A method known as Robichek-Van Horne (Herbst 1982) analysis addresses different length holding periods in the context of opportunity costs. This type of analysis, also known as abandonment analysis, is geared toward ex post decisions or decisions after an investment has been made. The opportunity cost of the future revenues that can be generated by an investment at various points in time is compared to the opportunity cost of the salvage value of the investment at that point in time. When a point in time is reached that the salvage opportunity cost is greater than the revenue opportunity cost, it is time to abandon the asset.

Herbst (1982) compared R-VH analysis to a method of annualizing the flows from an investment given different length holding periods to allow comparison between the holding periods. The annualized cost for each holding period of n number of years is determined by dividing the net discounted cost of the asset by the appropriate factor for a present value of an annuity. The holding period with the lowest annualized cost is the optimal holding period for the asset. Recall that R-VH analysis is geared toward ex post decisions. Herbst's method of annualizing the cash flows of different investment lives is a simpler method of evaluating the range of possible holding periods before the investment is made. However, Herbst illustrates annualizing the cash flows for each potential holding period yields the same optimal holding period as R-VH analysis applied at time 0.

Impact of Tax Legislation

Tax benefits and consequences are very important to any capital investment analysis. Hrubovack and Le Blanc (1985) measured the result of selected tax policies on firm growth and capital investment from a macroeconomic standpoint. They estimated tax policies between 1956 and 1978 stimulated net investment in agricultural equipment by more than $5 billion and net investment in agricultural structures by more than $1 billion. Their conclusion is that investment tax policies lower a firm's cost of capital, provide incentive for investment, and allow greater growth of firms over time.

The net discounted cost of a depreciable capital asset is often viewed as the costs of owning and maintaining the asset (i.e maintenance and depreciation expense) less the tax benefits generated by the asset. These tax benefits can have a cash and non-cash impact on equity. Tax depreciation deductions increase after-tax income and thus increase firm equity. However, these deductions often create a contingent tax liability, deferred taxes, that is realized at the time the asset is sold. Therefore, the full equity impact of the tax benefits consists of two components, the deductions and the liability realized on the asset sale.

Deferred taxes in regard to depreciable capital investments are the result of the Internal Revenue Code permitting more rapid expensing of an asset for income tax purposes than market forces substantiate. This creates a potential taxable gain due to the asset's fair market value being greater than its tax basis. Thus a firm accrues a contingent liability within the holding period which is only realized upon disposal of the asset. Discounted cash flow analysis captures the full equity impact of deferred taxes at the end of the holding period, but does not capture it throughout the holding period. Previous research has not addressed balance sheet issues of reduced liquidity and equity due to deferred tax throughout the investment life.

Research efforts have focused on the impact of tax legislation on optimal machinery decisions. Chisholm (1974) used standard Net Present Value techniques to determine the optimal replacement age of machinery under differing tax structures. Chisholm immediately points out a condition that is generally present in machinery replacement analysis. He states, "While it was perhaps natural to develop the theory of capital replacement in terms of profit maximization, this objective commonly poses severe problems of measurement owing to the difficulty of identifying the returns attributable to the use of a particular machine. The conventional method of overcoming this problem is to reformulate the profit maximization problem as one of cost minimization." His model found the optimum replacement period by discounting the cost and related tax benefits for a machine given differing lengths of ownership. The optimal replacement policy under this type of scenario is to continue to hold the current machine until the marginal cost of holding the machine for a further year exceeds the annualized cost a new machine. This technique is identical to the basic principle of R-VH analysis mentioned above.

The basic formulas of Chisholm's model are as follows. The after-tax present value of the stream of costs for a single machine is expressed in equation 1.

$$Q_n = (M_o - M_n[1+r]^{-n}) + (1-T)(\sum_{1}^{n} R_k[1+r]^{-k})$$
$$- T(I[1+r]^{-1}) - T(\sum_{1}^{n} D_k[1+r]^{-k}) \qquad (1)$$
$$+ T([\sum_{1}^{n} D_k - M_o + M_n][1+r]^{-n})$$

Where:

n = replacement age measured in years
r = the firm's after tax discount rate
M_o= acquisition cost of a new machine
M_n= resale value of a machine aged n years
R_k= machine operating cost in year k
D_k= amount of a depreciation allowance in year k
I = amount of an investment allowance
T = the firm's rate of income tax
Q_n= after-tax present value of the stream of costs for a single machine

The first line of equation 1 is the cost of the investment less its discounted resale value plus discounted operating costs net of the tax deduction for those costs. The second line is the discounted investment allowance and discounted depreciation deductions. The last line is the discounted taxable gain(loss) on sale of the asset

To calculate the present value of the cost for an infinite series of identical machines, Chisholm used equation 2.

$$V_n = \frac{Q_n}{1-(1+r)^{-n}} \qquad (2)$$

Where:

V_n= after-tax present value of the stream of costs for an infinite chain of identical machines, each replaced at age n years.

Q_n= after-tax present value of the stream of costs for a single machine

n = replacement age measured in years

r = the firm's after tax discount rate

By combining equation 1 and 2 and multiplying both sides of the equation by r the complete relationship for amortized cost is equation 3.

$$rV_n = \frac{r}{1-(1+r)^{-n}} \Big((M_o - M_n[1+r]^{-n}) + (1-T)\Big(\sum_1^n R_k[1+r]^{-k}\Big) - T(I[1+r]^{-1}) - T\Big(\sum_1^n D_k[1+r]^{-k}\Big) + T\Big(\Big[\sum_1^n D_k - M_o + M_n\Big][1+r]^{-n}\Big) \Big) \qquad (3)$$

Equation 3 is then evaluated for n=1,2,3...; and select the integer value of n which amortized cost is a minimum (V_n^*). Equation 1 is evaluated for n=1,2,3...; to determine the marginal cost between years. The optimal replacement policy is to trade in year n where $(Q_{n-1} - Q_{n-2}) < rV_n^* < (Q_n - Q_{n-1})$.

Chisholm applied his model by analyzing the sensitivity of optimal replacement periods to key factors under two different sets of tax laws in Australia. The more favorable of the two sets of laws allowed 20% investment allowance in the first year of machine ownership and more accelerated depreciation. The less favorable eliminated the first year allowance and added two years to the depreciation period. He concluded optimal replacement period was sensitive to tax rate and discount rate under more favorable tax laws and only sensitive to discount rate under less favorable requirements. He also concluded that the amount of cost reduction created by tax incentives similar to the first year allowance, i.e. Investment Tax Credit, were primarily sensitive to tax bracket. Also noted was that his calculated optimal replacement periods were longer than those observed by most producers used in actual production.

Kay and Rister (1976) commented on Chisholm's research and further applied his models and technique to U. S. tax scenarios. They agreed after-tax discount rate had the greatest effect on optimal replacement policy. They also agreed the derived optimum replacement periods were longer than the periods producers held machinery in actual practice. They offered a possible explanation for the difference between optimal year and actual practice. They noted the increased yearly cost of shorter replacement periods was often small. Thus, they concluded the financial penalty for early replacement is often minor.

Kay and Rister concluded investment tax credits and additional first year depreciation had notable effects on optimal replacement age while differing methods of tax depreciation had little effect. They continued by noting repair costs have a substantial influence on optimal replacement periods. When they changed the repair expense equation from a function increasing at a decreasing rate to increasing at an increasing rate the replacement periods dropped sharply. Also a breakdown premium, a lump sum charge for downtime, produced substantially shorter replacement periods.

Relevant Internal Revenue Code Provisions

Depreciable Business Property and Disposal

All analysis of tax provisions is subject to the laws outlined in the Internal Revenue Code (IRC). A review of current laws is important to fully understand the mechanics of this research. It is convenient to discuss the basic provisions relating to depreciable business property at this point to preface the work of Patrick (1991).

Since the tax reform act of 1986 depreciation deductions for personal property acquired after 1986 used in a trade or business are determined under IRC section 168. Agricultural machinery is typically required to use a seven-year class life and depreciated under either the 150% declining balance or straight line methods. The adjusted basis for depreciation and gain/loss calculations of these assets, defined by IRC 1011 is generally the assets' cost less depreciation deductions taken under 168. Any realized gain (loss) on sale or disposition of these assets is defined by IRC 1001 as the excess (deficit) of the amount realized on sale or disposition over (under) the adjusted basis.

It is important to note that depreciable business property is not considered a capital asset in the context of the IRC. Thus any gain (loss) resulting from the sale or disposition of depreciable business property is not simply a capital gain (loss). Any loss is normally treated as a section 1231 loss and thus can be used to offset other ordinary income. Any gain is separated into depreciation recapture and long-term capital gain. Depreciation recapture under IRC 1245 is equal to the lesser of the gain recognized or all the depreciation taken or allowed to be taken on the asset. Section 1245 recapture is treated as ordinary (not capital gain) income. Any gain remaining after depreciation recapture is treated as long-term capital gain income subject to a maximum tax rate of 28%. Generally, with depreciable business assets, all gain is depreciation recapture because the amount realized is seldom greater than the original cost. This recapture will be treated as ordinary income, but like capital gain income, will not be subject to self-employment taxes. Conversely any 1231 loss will not offset business income subject to S.E. taxes.

Accrued Liability Concept

Generally with depreciable business assets all gain is depreciation recapture because the amount realized from the asset sale is seldom greater than the asset's original cost. In the context of this research, all asset's analyzed are assumed to decrease in fair market value from the date of purchase. All taxable gain (deferred taxes) on the sale of assets is assumed to be ordinary income recapture. The taxable gain on an asset's sale adds to the asset's cost just as depreciation deductions reduce the asset's cost. As more rapid expensing of an asset for income tax purposes than market forces substantiate creates a potential taxable gain, the firm accrues a cost related to the asset. This cost is generated within the holding period of the asset but is only recognized on disposal of the asset.

The taxable gain on the sale of the assets adds to the asset's cost just as depreciation deductions reduce the asset's cost. The rapid expensing of an asset for income tax purposes is beneficial from a cash flow standpoint. The firm receives the depreciation deductions (tax benefits) first and must pay the accrued liability later. However, the accruing of this liability may not be beneficial from an income and equity standpoint in some cases. A significant portion of the asset's total cost can be this contingent liability. Instead of the assets costs being recognized throughout the asset's holding period, the cost of the contingent liability is only recognized at disposal.

Further, like-kind exchange treatment for tax purposes allows this contingent liability to be recognized by reducing the equity in a replacement asset as opposed to recognition in a cash transaction. Thus, a significant portion of an asset's cost can remain a contingent liability on the balance sheet even after the asset is disposed. Again this is beneficial from a cash flow standpoint but may not be beneficial from an income and equity standpoint.

The taxable gain on an asset's sale adds to the asset's cost. The accrued liability of deferred taxes is essentially the accrued asset cost. This cost is only recognized at the time of asset disposal. Further, this cost can be recognized in a non-cash transaction if like-kind exchange treatment is used.

Deferred Taxes and Like-Kind Exchange

Realized taxable gains on the sale of depreciable capital assets are not always required to be recognized. Nonrecognition of gains and losses on exchanges of property held for productive or investment use is covered by IRC Section 1031. Under 1031 the basis of the new (replacement) asset is reduced by the unrecognized gain pertaining to the old (replaced) asset. This type of treatment is commonly referred to as like-kind exchange treatment.

Deferred taxes are essentially the tax effects attributable to the sale of an asset. Deferred taxes add to an asset's cost in the same manner as tax depreciation deductions decrease an asset's cost. Deferred taxes also decrease an asset's realizable value (fair market value less tax on sale). Thus, deferred taxes have cost as well as balance sheet considerations.

Like-kind exchange treatment allows the payment of deferred taxes to be delayed if the asset being sold is replaced with another depreciable asset. The deferred taxes of the replaced asset are required to be realized, but at a later date. In exchange for the delayed realization, the tax basis of a replacement asset is reduced at the time of the replacement's purchase. This has implications with respect to both the cost and balance sheet considerations of deferred taxes.

From a cost standpoint, the cost of the replaced asset and the replacement are affected. The payment of the replaced asset's deferred taxes is avoided until a later date. This reduces the cost of the replaced asset's deferred taxes in a present value sense. However, the initial reduction in the replacement asset's tax basis reduces the future tax depreciation deductions (future tax benefits) that can be generated by the replacement. Essentially the payment of deferred taxes at the time of the replaced asset's sale is traded for less depreciation deductions over the life of the replacement. Thus, the cost of the replaced asset's deferred taxes affects the replacement asset's cost.

From a balance sheet standpoint the liability of deferred taxes is essentially unaffected by an asset sale and purchase under a like-kind exchange. If the deferred tax liability is paid, recognized in a cash outflow, the balance sheet liability is eliminated. However, with a like-kind exchange the liability is unaffected. Suppose a replaced asset has a fair market value (FMV) of $20,000 and a tax basis of $0. If a replacement had a cost and FMV of $50,000 it would have a beginning tax basis of only $30,000 (50,000 cost - 20,000 gain on the replaced asset's sale). Thus the balance sheet liability of having an asset with a FMV $20,000 greater than its tax basis is unchanged. The replacement essentially inherits the replaced asset's deferred tax liability.

A like-kind exchange affects both cost and balance sheet aspects of deferred taxes. The reduction of tax basis in replacement assets affects the discounted cost of the replaced and replacement assets as well as maintaining a deferred tax liability on the balance sheet. The current payment of tax on the sale of the replaced asset is traded for a higher cost of the replacement asset (less tax benefits) and less equity (lower realizable value) in the replacement.

While non-recognition of gains is often viewed as beneficial to taxpayers, they often do not have a choice between recognition and non-recognition. Like-kind exchange treatment is required when one asset is traded in on its replacement. If the old asset is sold to a third party like-kind treatment can be avoided. The rules pertaining to depreciation recapture were created to prevent the popular avoidance of like-kind treatment. Before recapture, taxpayers could recognize gains on the sale of depreciable assets totally as capital gains. Capital gains tax rates in the past were much lower than the rates on ordinary income. Under this tax scheme, taxpayers could use accelerated depreciation to quickly offset their ordinary income taxed at high rates and then recognize the gain taxed at low capital gain rates.

Even with depreciation recapture it is not always simple to determine if like-kind exchange treatment is a benefit from a cost standpoint. Like-kind exchange treatment creates a cost trade-off. The current payment of a gain is delayed. But for this delay, less depreciation deductions will be received in the future. If the present value of paying the gain in the future instead of currently is greater than the present value of the lost depreciation deductions, like-kind exchange treatment is beneficial.

Like-Kind Exchange and After-Tax Cost

Patrick (1991) compared the discounted cost of machinery investments given the alternatives of selling to a third party versus trade-in. Put another way, he compared machinery costs with and without like-kind exchange treatment. The important issue in Patrick's analysis is self-employment (SE) taxes. A recognized gain is not subject to the 15.3% SE taxes imposed on farm income. Depreciation deductions reduce farm income as well as reduce SE tax liability. When a taxpayer is taxed on the gain presently, he or she has the full basis of the new asset to offset future farm income and self employment taxes.

In 1991 self employed individuals were taxed 15.3% on their SE income up to $53,400 and 2.9% on SE income between $53,400 and $125,000. Patrick found that it is generally beneficial for producers with incomes lower than the upper limits on SE tax to recognize gains presently and retain the full basis of their replacement assets. For taxpayers with farm incomes above $53,400, it is not generally beneficial to currently recognize gains because the added depreciation deductions would not offset future SE taxes. Put another way, if your income is below the SE limit, the present value of your future depreciation deductions is greater than the present value of paying the gain on the sale of the original asset at a later date.

Patrick's work addressed the cost aspect of deferred taxes and like-kind exchange. He estimated under what conditions it is more beneficial to pay the tax on the sale currently instead of paying it later along with receiving reduced depreciation deductions in the future. Patrick did not address the balance sheet aspect of deferred taxes and like-kind exchange treatment.

Summary

Casler's discounted cash flow illustrations provide an appropriate method of evaluating investment's value (cost), but these methods do not involve consideration of accrued liabilities during the investment life. Herbst's illustration on optimal holding periods are also totally cost focused. His optimal holding period is defined by lowest cost, no liability during the investment life is considered. This research will combine the techniques illustrated Casler and Herbst with the consideration of deferred tax liability throughout the investment life.

Chisholm along with Kay and Rister analyzed the effects of tax policies and firm factors such as cost of capital on machinery costs and holding periods. They supplied important information on the sensitivity of machinery costs to discount rates and marginal tax rates. They specifically addressed tax considerations with replacement assets. However, their formulas implicitly realized in a cash transaction the tax effects attributable to the sale of each machine. Thus, they considered replacement machines outside of like-kind exchange treatment. This research will specifically address replacement assets costs outside and within a like-kind exchange context.

Patrick address like-kind exchange treatment from a discounted cost perspective. He provided insight as to when like-kind exchanges benefit overall asset costs. However, his analysis was strictly cost based and did not address the contingent liability of deferred taxes that could accumulate from like-kind exchange treatment.

The issue of deferred taxes and like-kind exchange needs to be developed further. If deferred taxes represent a high percentage of the replaced asset's net discounted cost, there is a potential for the cost of an identical replacement to be materially different than that of the original asset. Further, like-kind exchange treatment could lead to a material accumulation of accrued asset cost on the balance sheet.

Whole Firm Analysis

Whole-Firm Analysis Concepts

As stated earlier, most capital investment analysis focuses on the marginal effects of the investment only and its discounted and undiscounted cash flows. Whole-firm financial analysis involves three aspects: 1)the feasibility of a financial plan in terms of liquidity and repayment capacity or more simply stated cash flow, 2)the risk of the plan in terms of solvency or leverage, and 3)the profitability in terms of income. Discounted cash flow analysis provides information to assess feasibility and profitability by providing discounted cash flow and discounted cost information over the life of the investment. However, information on deferred taxes relative to the fair market value of the asset is not provided throughout the holding period to assess the interim effects on firm value and risk.

Variables exogenous to the net discounted cost calculation effect non-cash and cash endogenous variables within the net discounted cost calculation. Tax depreciation deductions are a cash endogenous variable while the deferred taxes are a non-cash endogenous variable with the two resulting in the net tax benefits or net impact on equity. The important issue is that tax depreciation deductions and deferred taxes have differing effects in terms of whole-firm analysis. Both effect the cost of the investment (profitability). However, the depreciation deductions affect cash flow (feasibility) while the deferred taxes effect solvency (risk). An exogenous variable to the net discounted cost calculation, such as tax rate, can have opposite effects on the measures of cash flow and solvency. A high tax rate increases cash flow due to the larger tax deductions. But the high rate has a negative impact on the firm in terms of solvency as the higher rates increase deferred taxes. Thus, what makes the investment more attractive in one measure makes it less attractive in another.

Research has shown cash alone can be a poor and deceiving measure of financial performance. Newport and Lins (1990) calculated and documented the common large differences between cash and accrual income of Illinois farms. They also noted the relative differences between the two income measures vary due to differing financial characteristics of the farms examined. The Farm Financial Standards Task Force (1991) agrees cash is a poor measure of farm income. The task force places heavy emphasis on the use of accrual accounting methods for measuring farm income and analysis of business performance. Tax incentives providing immediate cash gains for investment or consumption should be analyzed for accrual income and long-term equity effects.

The Farm Financial Standards Task Force also recommends balance sheets listing assets at their market value include an estimate of deferred tax liability. This is due to the fact that market values of assets often include gains not yet taxed. The deferred tax liability on the balance sheet offsets asset values and thus lowers firm equity. La Due (1991) showed that deferred taxes amounted to approximately 20% of the value of the assets of New York dairy farmers. He also noted deferred taxes as a percentage of assets increased with firm size. Not all deferred tax liability is due to tax depreciation. Increases in the value of land and raised breeding stock are common sources of substantial deferred tax liability.

Whole-Firm Machinery Selection

Previous research has addressed tax laws relating to depreciable capital investment from a whole-firm perspective. Baker (1982) along with Reid and Bradford (1987) used a whole-firm perspective in analyzing the sensitivity of machinery selection to tax laws. They combined the NPV techniques within a mathematical programming model to analyze the equilibrium effects of selected tax provisions on farm machinery selection. They noted a NPV "partial budgeting" model has problems identifying and valuing changes in the firm's cost and returns, especially opportunity costs. Further, a NPV model does not consider constraints on production and investment opportunities.

Their research concluded optimal machinery sets did not change with varying tax scenarios, but annualized costs of the machinery sets varied greatly. Increased tax rates, which increase the value of tax deductions, substantially lower machinery costs. Also, up front tax saving from investment, such as those provided by investment tax credit, made the largest influence on machinery costs. Baker also noted the high sensitivity of costs to tax rates and the cost of capital used in discounting.

Baker along with Reid and Bradford combined the whole-firm perspective into their machinery investment analysis. They incorporated some additional investment constraints and opportunity costs of the firm to the NPV model. However, their models optimized the machinery complements in a static equilibrium. They did not fully address the effects on the firm over a set planning period nor address deferred tax implications on firm equity.

Deferred taxes affect a firms risk by reducing liquidity and solvency. The related decrease in equity and increase in solvency ratios can be a production and investment constraint. Deferred taxes were not among Baker nor Reid and Bradford's constraints.

Analysis Over Multiple Periods

Holistic firm analysis and planning over multiperiods is often addressed using the basic concepts of the firm growth model. Firm growth models generally are a function of rate of return on assets, interest rate on debt, level of financial leverage, and rates of taxation and consumption. The following basic model is from Barry (1988).

$$G = (rP_a - iP_d)(1-t)(1-c) \quad (4)$$

Where:
- G = rate of growth in equity capital
- r = average net rate of return, except for interest(i) and taxes(t), on total assets owned by the firm
- i = average interest paid on debt
- t = average rate of income taxation
- c = average rate of withdrawals for family consumption, dividends, and other non-business flows
- P_a= ratio (or proportion) of assets to equity
- P_d= ratio (or proportion) of debt to equity (leverage ratio)

Eginton (1980) used basic firm growth principles to specifically analyze tax policies effects on firm growth. Eginton developed a 30-year planning model to study the effect on selected tax provisions on firms with differing financial characteristics. Growth was measured by accumulation of owned land. He concluded cash flow rather than equity is the limiting factor in firm growth. Tax policies which allowed immediate cash benefits which could be used for investment fueled growth. However, growth was highly sensitive to consumption.

Eginton noted farms with differing dominant asset types (i.e. land vs. highly mechanized) received differing levels of benefit from selected tax policies. He stressed that the importance inflation of land prices benefitted large farms owning more land. Although he discussed the importance of capital gain treatment, he makes no mention of deferred taxes limiting equity until the end of the 30-year simulation.

Eginton's work exhibited the logic of the basic firm growth model. Firms' with excess returns after taxation and consumption, increased equity. However, his work did not relate the interim effect on equity of deferred taxes. His research emphasizes the need to addresses a specific firm's investment, consumption and taxation functions.

Summary

Discounted cash flow analysis is a popular method of addressing investment decisions. However, focusing solely on the differential cash flows of the investment is not always a thorough analysis. Whole firm analysis should involve the three measures of cash flow, income, and solvency. An investment may be attractive in one measure, but unattractive in another.

Machinery investment analysis has been combined with firm models to address differing types of firms' machinery investment decisions and prospects for future growth. However, it was not the focus of the previous research discussed to specifically address deferred tax issues. Deferred taxes were not considered among the production and investment constraints in these firm models. Deferred taxes could place limits on a firm due to reduction of solvency.

This research addresses the significance of deferred taxes in a whole-firm context. Deferred tax liability is addressed in relation to investment assets' fair market value and costs as well as in relation to whole firms' financial situations.

CHAPTER III

INTEGRATING DEFERRED TAXES INTO CAPITAL INVESTMENT ANALYSIS

The term modeling is often used to describe any type of activity that tries to represent a real life situation for subsequent analysis. The modeling requirements needed for this research involve isolating the relative importance of deferred taxes from an investment and whole-firm perspective. The two perspectives will be developed from hypothetical situations, or stated another way, in an example format. No specific data will be accumulated or analyzed.

Individual Asset Analysis

General Requirements

For the specific asset analysis, the model needs to be able to calculate the discounted cost of an example investment and isolate deferred tax liability throughout the investment's life. This will allow the value of the deferred taxes related to a specific asset investment to be assessed against the asset's fair market value (FMV) over the holding period. Further, the relative amount of the investment's discounted cost attributable to deferred taxes can be addressed. The model also needs to be capable of incorporating a range of exogenous variables such as tax and discount rates to determine the sensitivity of deferred tax values to these factors. The model must also be able to calculate the discounted cost of replacement assets and assess deferred tax implications of like-kind exchange treatment.

Discounted Cash Flow Equations

Four basic components will be used in the discounted cash flow calculations: maintenance costs, loss in fair market value, tax depreciation deductions, and tax effects attributable to the sale of the asset. The four basic components are represented by equations 5 through 9. The cumulative discounted maintenance costs are illustrated by equation 5.

$$MC_n = (1-t-se)\left(\sum_{1}^{n} R_n [1+r]^{-n}\right) \tag{5}$$

Where:
MC_n = cumulative discounted maintenance costs over n years
t = the firm's rate of income tax
se= the firm's rate of self-employment tax
R_n= machine maintenance cost in year n
n = the asset's holding period measured in years
r = the firm's after-tax discount rate

The asset's discounted loss in value is equation 6.

$$VL_n = M_o - M_n [1+r]^{-n} \tag{6}$$

Where:
VL_n= the discounted loss in value over n years
M_o= the acquisition cost of the machine
M_n= the resale value (FMV) of a machine aged n years

The cumulative discounted tax depreciation deductions are equation 7.

$$DD_n = (t+se)\left(\sum_{1}^{n} D_n[1+r]^{-n}\right) \tag{7}$$

Where:
DD_n = cumulative tax depreciation deductions over n years
D_n= tax depreciation allowance in year n

The tax effects attributable to the sale are represented by equation 8.

$$DT_n = t\left(M_n - \left[M_o - \sum_{1}^{n} D_n\right][1+r]^{-n}\right) \tag{8}$$

Where:
DT_n= the discounted tax effect of the asset sale in yr n

Thus the equation for net discounted cost is equation 9.

$$NDC_n = MC_n + VL_n - DD_n + DT_n \tag{9}$$

Where:
NDC_n= the net discounted cost of an asset sale over n years

Fair Market Value and Maintenance Expense Equations

To accurately calculate optimal holding periods and calculate deferred taxes, an accurate fair market value of the investment asset must be known throughout the investment's life. An objective approach to estimating agricultural machinery values is the use of formulas developed by the American Society of Agricultural Engineers (1992). These formulas are a function of asset age in years and list price. Equation 10 is the American Society of Agricultural Engineers

(ASAE) value formula with the specific parameters (0.68 and 0.94) for determining the value of wheel tractors. The wheel tractor parameters will be used in the individual asset analysis in chapter 4. The tractor parameters are a compromise between the more rapid depreciation parameters for harvest equipment and the slower parameters for tillage equipment and other non self-propelled equipment.

$$\textit{Value} = \textit{list price} \times 0.68 \times 0.94^{age} \quad \textbf{(10)}$$

Equation 10 is modified for this research to include an exogenous variable for the percent actual cost is below list price and the list price variable is replaced by actual cost. The two modifications allow the actual cost needed for tax calculations to be used directly in the FMV calculations and the amount of first year loss in fair market value to be adjusted for purchases below list price. The modified equation is 11.

$$\textit{Value} = (\textit{cost}/(1\text{-}\%\textit{cost is below list price})) \times 0.68 \times 0.94^{age} \quad \textbf{(11)}$$

Asset operating and maintenance expenses are also determined by an ASAE formula, equation 12. Accumulated operating and maintenance expenses are a function of total machine hours. For both the original and replacement assets, beginning accumulated hours and yearly use are required exogenous variables. The model simply adds the yearly use to total hours to arrive at a new accumulated expense each year. The yearly expense is the difference between the current and prior years accumulated expense figure.

$$Accum\text{exp} = list\ price \times .006944 \times (totalhrs/1000)^2 \tag{12}$$

Internal Revenue Code Provisions

Tax basis and tax depreciation must be calculated in accordance with the Internal Revenue Code. Farm machinery is generally considered an asset with a 7-year class life. 150% declining balance or straight-line depreciation methods may be used to determine yearly tax depreciation deductions. For this analysis it is assumed all assets are depreciated using the 150% declining balance method with the half-year convention. Code section 179 instant expensing will also be used to gain the quickest possible tax benefits.

For replaced assets subject to like-kind exchange treatment, the beginning tax basis in the replacement asset is the asset's cost less any deferred gain on the previous asset. The equation for determining the tax basis of replaced assets is equation 13.

$$TB_t = FMV_d - (TB_d - IE - \sum_{1}^{n} D_k) \quad (13)$$

Where:
TB_t = beginning tax basis of replacement asset
TB_d = beginning tax basis of replaced asset
FMV_d = fair market value of replaced asset at sale date
IE = section 179 instant expensing amount
D_k = tax depreciation allowance in year k of asset life

Concepts and Related Calculations

Figures 1 thru 3 illustrate some of the necessary calculations and concepts to be modeled. Figure 1 illustrates how the net discounted cost of an asset can be separated into the costs of owning and maintaining an asset and the net tax benefits generated by the asset. The top line in Figure 1 is the cumulative discounted maintenance cost of a $100,000 depreciable asset plus the discounted loss in the asset's fair market value (depreciation). The bottom line in Figure 1 is the cumulative discounted tax benefits generated by the asset. The tax benefits are represent in Figure 1 as a negative cost because they offset asset costs. The tax benefits are the net result of tax depreciation deductions less any tax effects attributable to the sale of the asset. The maintenance and depreciation costs (MC_n + VL_n) of the asset (top line) less the tax benefits (DD_n - DT_n) generated by the asset (bottom line) result in the net discounted cost of the asset (MC_n + VL_n - DD_n + DT_n) (middle line) in Figure 1.

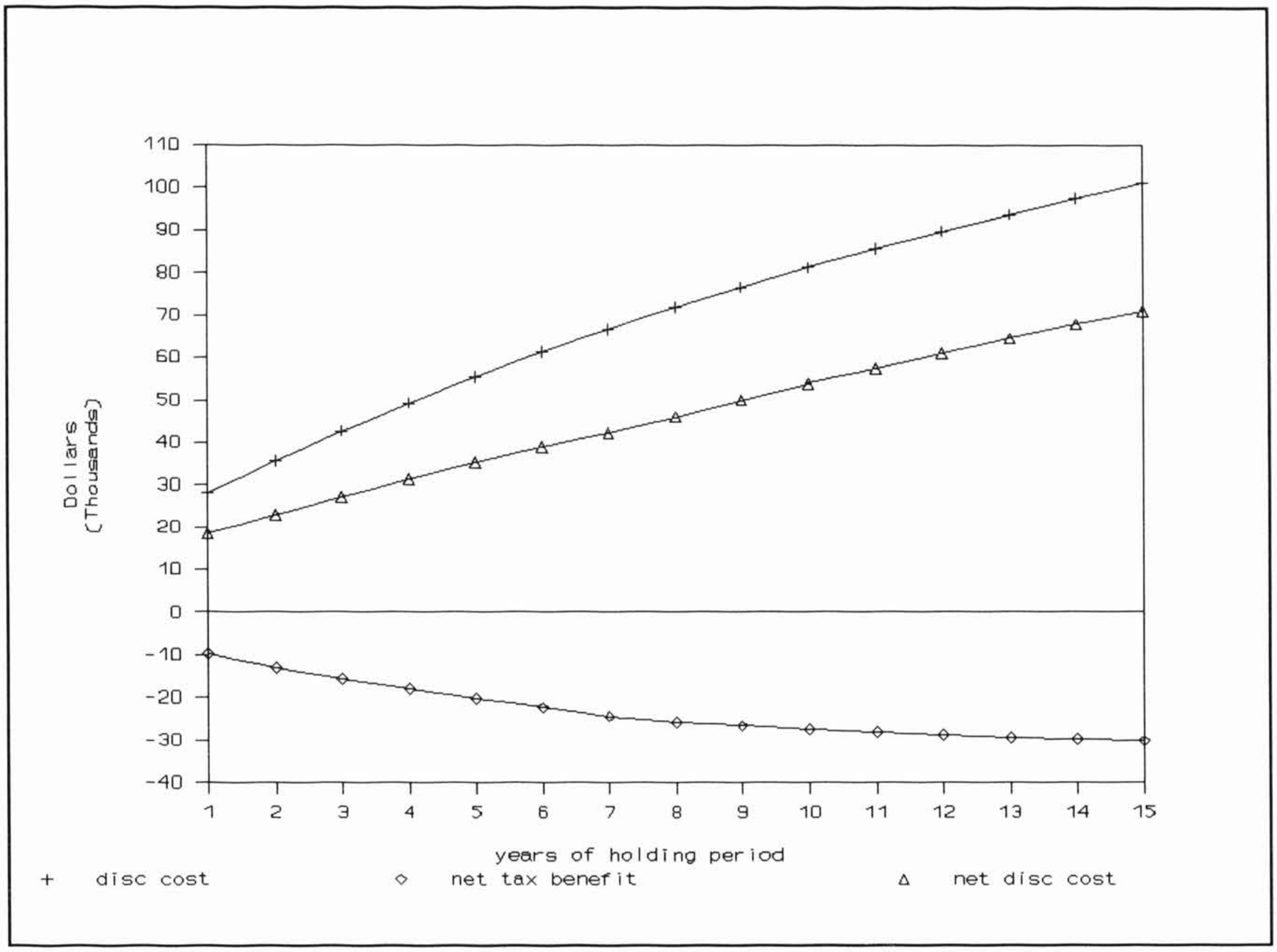

Figure 1. Cumulative Net Discounted Cost in Relation to Cumulative Costs and Cumulative Tax Benefits

The discounted values illustrated in Figure 1 are determined from the cash flows resulting from the asset's acquisition, operating costs, tax effects, and sale. Fair market value depreciation is considered in traditional discounted cash flow analysis in the same manner as deferred taxes. The asset's value decreases throughout the holding period, but cash flow analysis considers the value decrease only at the end of the holding period. Deferred taxes are only considered at end of the holding period as well. The loss in the asset's fair market value (FMV depreciation) over the holding period and any tax effects attributable to the sale of the asset are realized in cash flows in the last year of the holding period at the time of the asset sale.

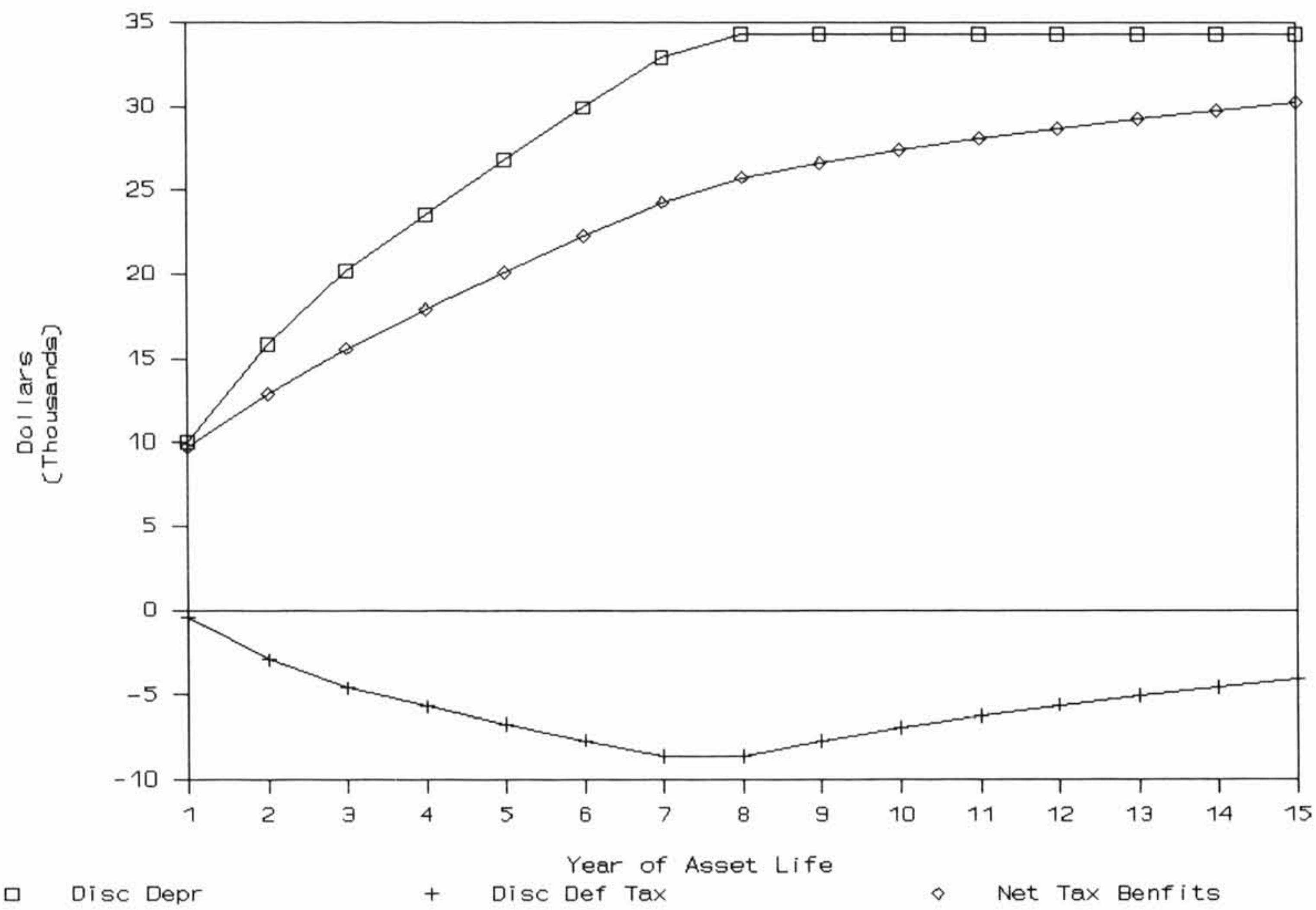

Figure 2. Net Tax Benefits

The tax benefits generated by an asset are the net result of tax depreciation deductions less any tax effects attributable to the sale of the asset. Figure 2 illustrates the two components of the tax benefits. The top line is the cumulative value of the discounted yearly tax depreciation deductions (equation 7). The bottom line in Figure 2 represents the potential taxable gain resulting from the asset's fair market value being greater than the asset's tax basis at the end of each year (equation 8). The net of the top and bottom line illustrates the net tax benefits generated by the asset, the middle line.

Traditional discounted cash flow analysis involves the top line in Figure 2 throughout the holding period and the bottom line only in the year of disposal when the gain on sale is recognized in a cash transaction. However, the contingent liability from deferred taxes exists throughout the holding period. The true impact of the income tax provisions on the firm's equity and risk is the net tax benefits, the middle line in Figure 2.

Figure 3 represents the relative value of deferred taxes to the example asset's fair market value. The points in Figure 3 are calculated by dividing the deferred tax liability at the end of each year of the asset's life by the asset's fair market value at the end of each year. Mathematically the relationship could be illustrated by equation 8 above (DT_n) divided by the variable M_n in equation 8. The relative amount of deferred taxes illustrates how much of the balance sheet equity in the example asset would be eliminated by the contingent liability from deferred taxes.

The tax rate used in the example calculations generating Figures 1 thru 3 is 25% In Figure 3, the relative value of deferred taxes stabilizes at 25% in the ninth year. This is due to the example asset becoming fully depreciated for tax purposes in year nine. With a tax basis of zero, the full

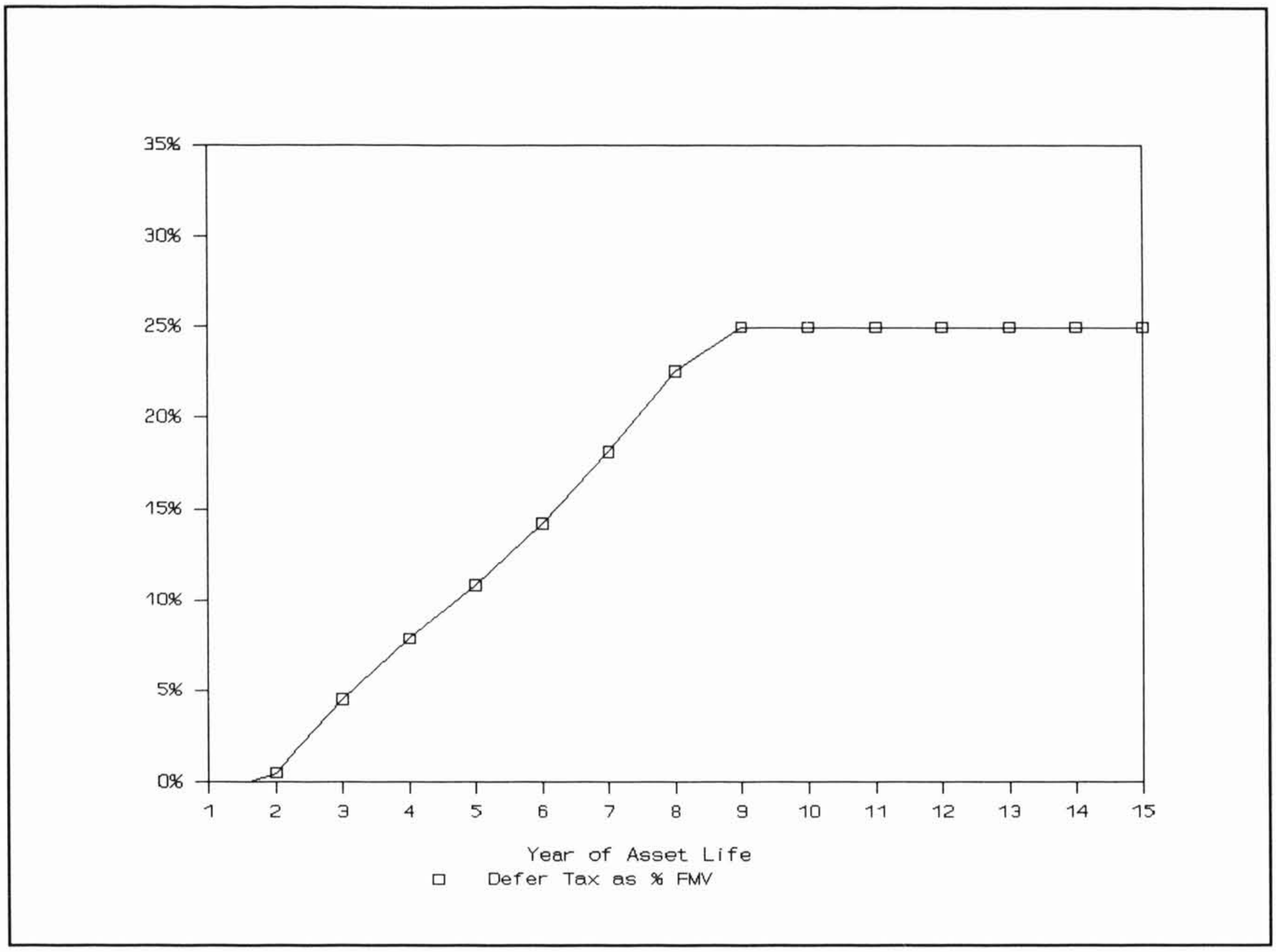

Figure 3. Deferred Tax Liability Relative to Asset FMV

value of the asset is taxable upon disposal. Thus, the relative amount of deferred taxes becomes equal to the asset's FMV multiplied by the tax rate after the tax basis of the asset reaches zero.

Method of Calculation

A microcomputer based spreadsheet application was developed to perform the necessary calculations in accordance with the equations and concepts outline in this chapter. Two basic components comprise the spreadsheet. The first part, the "asset system" uses the ASAE formulas and tax code provisions to calculate an example asset's operating and maintenance expense, tax depreciation deductions, tax basis, and fair market value over 25 years. The only exogenous variables required for these calculations are the asset's cost, cost below list price, hours use per year, and amount of first year Internal Revenue Code section 179 tax expensing.

The second part of the spreadsheet, the "discounting system", incorporates equations 5 thru 9 with the data generated in the asset system to determine net discounted cost. The additional exogenous variables required for this part are tax rate, self employment tax rate, and discount rate. An after-tax discount rate is used for discounting the cash flows and is endogenous based on the tax rate and discount rate exogenous variables. All discounted cash flows are accumulated from year 0 to year 1 thru 25 to allow calculation of net discounted cost and annualized cost for every holding period between 1 and 25 years.

The discounting system component of the spreadsheet also calculates deferred tax liability annually. Deferred tax liability is derived by multiplying the difference between the asset's FMV and its tax basis in each year by the tax rate. The liability is used for the DT_n parameter in equation 9 as well as comparing to the assets FMV in each year.

The ability to model like-kind exchanges is accomplished by expanding the asset system component of the spreadsheet. Exogenous variables for determining replacement asset values include asset cost, cost below list price, and hours use per year. Equation 13 is used to calculate the tax basis and tax deductions for a replacement asset given the data calculated for the original asset. The endogenous variables, such as tax deductions and fair market value of the replacement asset from the asset system component, are inserted into the discounting system component of the spreadsheet to determine net discounted cost and the other endogenous variables.

Whole-Firm Analysis

General Requirements

When analyzing the importance of deferred taxes in a whole-firm context more than one asset should be considered. Deferred taxes related to a single asset can be material relative to the fair market value of that single asset. However, it is less likely that a single asset's deferred taxes are material relative to a firm's entire balance sheet. The deferred taxes related to all the firm's depreciable capital investments should be considered when analyzing the balance sheet as well as other financial statements. A complete complement of depreciable capital investments should be combined with the firm's other financial information for analysis.

To analyze deferred taxes from a whole-firm perspective a simple balance sheet, income statement, and cash flow statement are required. More specifically a balance sheet is needed to examine solvency, an income statement to examine profitability, and a cash flow statement to examine feasibility. The model needs to be capable of illustrating a complete capital replacement strategy over a series of years to give insight on short- and long-run implications to solvency, income, and cash flow. Nonetheless the financial statements, calculations and assumptions need to be as simple as possible to allow focus on deferred taxes and particularly their effect on firm solvency. The model must be capable of simulating a series of like-kind exchanges involved in a capital replacement strategy and their impact on the entire firm. Specifically the model must simulate the complete replacement of the machinery complement a minimum of two times to fully estimate the material impact of deferred taxes related to like-kind exchanges.

Basic Assumptions

The calculations and assumptions associated with the firm's machinery complement are the most complex issues to address. It is not likely a firm would purchase and/or replace its entire complement in one year. The machinery complement simulated by the model should consist of individual assets of different ages. Thus, the separate assets, or groups of assets, of different ages must be accounted for individually to accurately calculate annual tax depreciation deductions, fair market values, and the tax basis of the entire complement.

Building on the premise that individual assets in the complement have different ages, it is assumed only part of the complement is purchased/replaced each year. For simplicity, it is assumed the age of the machinery is evenly distributed. Further, each age group or set has the same new purchase price. For example, $75,000 of machinery is purchased each year. This is interpreted as an equal amount spent on capital replacement each year, not necessarily a single $75,000 asset purchased each year.

While the tax calculations for the machinery complement will require considerable detail, the issues of FMV depreciation and maintenance expense can be greatly simplified. A set life for the machinery complement is assumed and straight-line (SL) FMV depreciation used. If an equal portion of the complement is purchased/replaced each year the use of SL depreciation will not effect the results as the constant trades will create a constant amount of FMV depreciation for the firm from year to year. All maintenance expense is assumed to be included in firm's net income estimate.

Method of Calculation

A microcomputer based spreadsheet was developed to calculate the financial information for analysis. This application is designed in two fundamental components, a financial statement component and the machinery system component. The machinery system component generates the FMV, tax basis, and yearly tax depreciation for the complete machinery complement. The financial statement component integrates the machinery complement's FMV, tax basis and yearly tax depreciation deductions with the firm's other financial information to complete the firm's financial statements.

For situations not involving like-kind exchanges only one tax calculation for the machinery complement is required. For situations involving like-kind exchanges, three tax calculations are required. The machinery complement must be completely replaced two times to fully estimate the material impact of deferred taxes related to like-kind exchanges. Thus, a tax calculation for the original complement, the first replacements, and the second replacements must be completed.

The yearly financial statements consist of the following items:

BALANCE SHEET:

<u>Assets</u>
Current Assets
Machinery

Total Assets

<u>Liabilities and Equity</u>
Machinery Debt
Deferred Taxes
Total Liabilities
Equity

Balance Sheet Ratios
Debt-to-asset ratio
Debt-to-asset ratio without deferred tax
Deferred tax to asset value ratio

INCOME STATEMENT:

Net Farm Income After Taxes
Net farm income before interest, FMV depreciation and taxes
Interest expense
FMV depreciation
Net farm income before tax
Tax expense

Net farm income after taxes

Tax expense
Net farm income before FMV depreciation & taxes
Tax depreciation
Taxable income
Taxable gain
Average tax rate

Tax expense

CASH FLOW STATEMENT:

After Tax Cash Flow
Net farm income before interest, FMV depreciation &tax
Interest payments
Tax payments
Loan principal payments
New machinery loans
Machinery purchases
Machinery disposal

After tax cash flow

In the individual asset analysis, equations can illustrate most of the specific calculations. With the financial statements involved in the whole-firm analysis, the best way to illustrate the method of calculation is with example financial statements. This will be presented in the procedures chapter as the example firm is developed for analysis.

Modeling Summary

The modeling requirements for both the individual asset analysis and whole-firm analysis are similar. The calculations relating to the specific asset(s) such as tax depreciation deductions, must be made first. Then the asset calculations are inserted into a discounted cash flow framework in the individual asset analysis and into a financial statement framework in the whole-firm analysis. Both models need the ability to calculate deferred taxes yearly for analysis throughout assets' holding periods.

This chapter has addressed the assumptions and calculations used in the following chapters. The individual asset analysis is addressed in chapter IV. The whole-firm analysis follows in chapter V.

CHAPTER IV

INDIVIDUAL ASSET ANALYSIS

This chapter analyzes deferred taxes in the context of an individual asset without considering the affects of deferred taxes on the entire firm. The analysis is organized in two parts. The first part addresses the deferred taxes of a single asset. The second part addresses the deferred taxes of a series of assets subject to like-kind exchange treatment.

Deferred Taxes of a Single Asset

Basic Discounted Cost Analysis

This first section illustrates the effect of a range of tax and discount rates on the net discounted cost of a depreciable capital investment. The net discounted cost calculations are performed using the equations and guidelines discussed in the individual asset analysis section of Chapter III.

Table I is a matrix of net discounted costs for an example asset given differing tax and discount rates. The example asset is assumed to have a cost of $100,000 and a expected life (holding period) of 10 years. The asset is depreciated for tax purposes using the quickest method possible, 150% double declining balance depreciation along with $17,500 instant asset expensing in the first year. The maintenance costs and loss in FMV needed for the net discounted cost calculations are determined by the ASAE formulas (equations 11 & 12). The exogenous variables for the ASAE formulas are a purchase price 15% below list and 500 hours of use per year.

TABLE I

TEN-YEAR NET DISCOUNTED COST

Disc Rate	Tax Rate 15%	25%	35%	45%	55%
2%	53,475	45,231	36,939	28,600	20,215
3%	56,030	47,611	39,109	30,526	21,862
4%	58,382	49,832	41,159	32,365	23,452
5%	60,550	51,906	43,097	34,124	24,987
6%	62,550	53,846	44,931	35,805	26,470
7%	64,397	55,660	46,667	37,414	27,902
8%	66,105	57,360	48,311	38,954	29,286
9%	67,686	58,954	49,871	40,430	30,624
10%	69,151	60,449	51,350	41,843	31,918
11%	70,511	61,853	52,754	43,199	33,170
12%	71,773	63,173	54,089	44,499	34,381
13%	72,947	64,415	55,357	45,746	35,554
14%	74,039	65,584	56,564	46,944	36,689

As can be seen from Table I, discount rate and tax rate have inverse effects on net discounted cost. A combination of the highest discount rate and the lowest tax rate creates the highest discounted cost. The results of Table I are intuitive. A high cost of capital (high discount rate) naturally increases costs. Tax deductions reduce asset costs.

A lower tax rate lowers the value of tax deductions resulting in a higher net cost.

The traditional discounted cost analysis used to determine Table I focuses only on costs. Deferred taxes are considered in the cost calculation only at the end of the holding period. In the next section, the issue of deferred taxes is addressed throughout the holding period from a balance sheet point of view.

Deferred Taxes Relative to FMV

The Farm Financial Standards Task Force recommends balance sheets listing assets at their market value include an estimate of deferred tax liability. This is due to the fact that market values of assets often include gains not yet taxed. Listing assets along with their corresponding deferred tax liabilities gives an estimate of the assets' realizable value. The deferred tax liability on the balance sheet offsets asset values and thus lowers firm equity.

Table II lists the relative percent of deferred taxes to the FMV of the example asset. The percentage is determined by dividing the deferred tax liability at the end of each year by the asset's FMV at the end of each year. The relative percentage is calculated throughout the 10-year holding period given the range of tax rates used in Table I.

Recall that in Figure 3, the relative value of deferred taxes stabilizes at 25% in the ninth year. The 25% column in

Table II provides the same information as shown in Figure 3. An asset increasingly accrues deferred tax liability until it is fully depreciated for tax purposes. With a tax basis of zero, the full value of the asset is taxable upon disposal. Any asset that is fully depreciated for tax purposes has a corresponding deferred tax liability equal to that asset's fair market value multiplied by the relevant tax rate.

TABLE II

RELATIVE PERCENTAGE OF
DEFERRED TAXES TO ASSET FMV

	Tax Rate				
Year	15%	25%	35%	45%	55%
1	0%	-1%	-1%	-1%	-2%
2	0%	1%	1%	1%	1%
3	3%	5%	6%	8%	10%
4	5%	8%	11%	14%	17%
5	7%	11%	15%	20%	24%
6	9%	14%	20%	26%	31%
7	11%	18%	25%	33%	40%
8	14%	23%	32%	41%	50%
9	15%	25%	35%	45%	55%
10	15%	25%	35%	45%	55%

The highest tax rate yields the lowest net discounted cost (Table I) but also yields the greatest risk in terms of solvency (Table II). The implication of this is that while a high tax rate lowers the investment's cost, it increases the deferred taxes related to that investment. Net discounted cost analysis alone could yield an attractive analysis in terms of profitability and feasibility. However, analysis of the solvency aspect related to deferred taxes could present important risk considerations to some managers. A manager subject to a high tax rate should consider deferred taxes in capital investment analysis.

For example, a highly leveraged manager subject to a high tax rate would have incentive to purchase equipment to take advantage of the large tax depreciation deductions the purchase would provide. However, the manager must keep in mind the purchase will accrue a considerable deferred tax liability in addition to any debt liability related to the purchase. Further, he or she should consider that any of the assets on the balance sheet which have a zero tax basis (completely depreciated) represent a deferred tax liability equal to the assets' FMV multiplied by the high tax rate.

Deferred taxes can significantly reduce the realizable value of assets on the balance sheet. All managers should consider the effect of deferred taxes on equity in investment decisions. Even if a manager is not currently subject to a high tax rate, he or she could be in a high tax bracket in the future. The next section specifically analyzes how deferred tax considerations could affect manager's optimal holding period calculations.

Optimal Holding Periods

As previously mentioned a range of feasible holding periods should be analyzed to determine what length holding costs of the 6- and 5-year holding periods are $8,848 and $9,043 respectively.

Recall that Kay and Rister determined optimal holding period was not highly sensitive to varying tax and discount rates and that the difference between the annualized cost of optimum holding periods and shorter holding periods is often small. Kay and Rister reasoned the small cost difference was the reason farmers in actual practice held machinery for shorter periods than the optimal holding periods calculated in their research. The shorter holding periods could also have risk benefits that may make them more attractive.

A manager concerned with deferred tax liability might choose a shorter than optimum holding period given the information in Table II and Figure 4. The 35% tax rate column in Table II shows deferred taxes to equal 25% of asset FMV at the end of year 7. Deferred taxes are 15% and 20% of asset FMV respectively at the end of year 5 and 6. The 5 and 6 year holding periods have a higher annualized cost but have lower deferred tax liability. A manager could lower the deferred tax liability associated with the asset by 10% of its FMV by holding it for 5 years instead of 7 at the cost of $288 (9,043 - 8,755) per year.

While optimal holding periods are not generally sensitive to tax rate, deferred taxes are obviously sensitive to tax rate. As the tax rate increases, the incentive to use shorter than optimal holding periods increases. Consider the 55%

column in Table II. A change from year 7 to year 5 produces a 15% difference.

The cost curve for the example asset illustrated in Figure 4 provides an opportunity to reduce deferred tax liability in exchange for a small increase in cost. This certainly does not imply the cost curves of all assets will provide such an opportunity. However, it does suggest the possibility is worth investigating.

Optimal holding periods defined by lowest annualized cost might not be "optimal" to all managers. Shorter holding periods can reduce deferred tax liability without significant cost increases in some cases. Kay and Rister asserted that the minor cost increases associated with shorter holding periods encouraged shorter holding periods in actual practice. Managers can have the advantages of newer equipment with only minimal cost increases. This research asserts that deferred tax liability could also encourage shorter holding periods. Managers can incur a small cost increase for a substantially lower deferred tax liability in some cases.

Discounted Cost Analysis Focusing on Deferred Taxes

Deferred taxes add to an asset's costs in the same manner as tax depreciation deductions lower an asset's cost. The calculations involved in determining the net discounted costs in Table I were determined using equation 9 presented in Chapter 3. If total net discounted cost (equation 9) is separated into its four components (equations 5,6,7 & 8), the amount deferred taxes contribute to an asset's overall cost can be assessed. The analysis in this section isolates the deferred tax component of net discounted cost.

Recall the asset illustrated in Figure 4 had an optimal holding period of 7 years with and annualized cost of $8,755. The total net discounted cost for the 7-year holding period is $50,296. This cost was calculated using a tax rate of 35% and a discount rate of 8%. The components of the discounted cost calculation for the asset are listed in Example 1.

Example 1:

$$\begin{aligned} MC_7 &= 15{,}476 \\ VL_7 &= 63{,}619 \\ DD_7 &= (40{,}291) \\ DT_7 &= \underline{11{,}492} \\ NDC_7 &= 50{,}296 \end{aligned}$$

$$DT_7 \;/\; NDC_7 =$$

$$11{,}492 \;/\; 50{,}296 = 23\%$$

In Example 1 deferred taxes add $11,492 to the net discounted cost of the asset. Deferred taxes amount to approximately 23% of the asset's total net discounted cost. If the discount rate is lower and the tax rate increased, the relative percentage of deferred taxes increases. Example 2 is the net discounted cost for the same asset given a 4% discount rate and a 55% tax rate. Example 2 illustrates that a substantial portion of an assets cost can be deferred taxes.

Example 2:

$$\begin{aligned} MC_7 &= 10{,}061 \\ VL_7 &= 54{,}212 \\ DD_7 &= (62{,}655) \\ DT_7 &= \underline{22{,}728} \\ NDC_7 &= 25{,}246 \end{aligned}$$

$$DT_7 \;/\; NDC_7 =$$

$$22{,}728 \;/\; 25{,}247 = 90\%$$

Both the work of Chisholm and Kay and Rister determined optimal holding periods were not highly sensitive to the exogenous variables of discount and tax rates. Thus, a range of discount and tax rates can be used in an analysis without considering significant changes in optimal holding period. However, the authors did determine net discounted cost was highly sensitive to discount and tax rates. It is obvious that deferred taxes are sensitive to tax rate as well. By varying the marginal tax and discount rate, the significance of deferred taxes to net discounted cost can vary dramatically.

TABLE III

DEFERRED TAXES AS A PERCENTAGE OF NET DISCOUNTED COST

Disc	Tax Rate				
Rate	15%	25%	35%	45%	55%
2%	11%	21%	37%	62%	108%
3%	10%	19%	34%	56%	98%
4%	9%	18%	31%	52%	90%
5%	8%	16%	29%	48%	83%
6%	8%	15%	26%	44%	77%
7%	7%	14%	25%	41%	71%
8%	6%	13%	23%	38%	66%
9%	6%	12%	21%	36%	62%
10%	6%	11%	20%	34%	58%
11%	5%	11%	19%	32%	54%
12%	5%	10%	17%	30%	51%
13%	5%	9%	16%	28%	48%
14%	4%	9%	15%	26%	45%

Table III presents a matrix of the relative magnitude of deferred taxes in relation to the example asset's net discounted cost given varying tax and discount rates. Table III illustrates that given a high tax rate and low discount rate a substantial portion of an asset's net discounted cost is deferred taxes.

The cost of deferred taxes accrues throughout the asset's holding period because the tax basis declines faster than the asset's fair market value. The asset's deferred taxes (accrued cost) are not fully recognized until the time of the asset's sale. A substantial portion of the asset's cost will be realized at the end of the holding period instead of being allocated over the holding period. From a cash flow and discounted cost standpoint this is beneficial. However, if the increasing accrued cost of deferred taxes and the corresponding liability are ignored during the holding period, a misleading perspective of asset costs can be presented.

Summary

The main points presented in the first four sections of this chapter are as follows; deferred taxes can substantially reduce the realizable value of assets on the balance sheet, deferred tax considerations can have relevance in optimal holding period decisions, deferred taxes can accrue a substantial portion of an asset's cost to the balance sheet and deferred taxes can delay payment of those costs until the year of disposal. The remainder of this chapter will build on these points in addressing deferred tax considerations with like-kind exchange treatment.

Like-Kind Exchange Analysis

Like-kind exchange treatments affect the cost and balance sheet aspects of deferred taxes. The reduction of tax basis in replacement assets affects the discounted cost of the replaced and replacement assets as well as maintaining a deferred tax liability on the balance sheet. The payment of tax on the sale of the replaced asset is traded for a higher cost of the replacement asset (less tax benefits) and less equity (lower realizable value) in the replacement. Given the above effects on replacement assets, does like-kind exchange treatment compound the negative aspects of deferred taxes already presented in this chapter?

The remainder of this chapter addresses the following with respect of like-kind exchange: 1) can deferred taxes affect the long-term realizable value of a string of replacement assets on the balance sheet, 2) can different lengths of individual asset holding periods affect the realizable value of a string of replacement assets on the balance sheet, 3) is there an important trade-off between delaying payment of asset costs and solvency, and 4) what are the long-term cost effects of delaying payment of a replaced asset's cost on the cost of replacement assets.

Realizable Asset Value

Like-kind exchange treatment allows the payment of deferred taxes to be avoided if the asset being sold is replaced with another depreciable asset. The deferred taxes of the replaced asset are required to be realized, but at a later date. In exchange for this realization at a later date, the tax basis of a replacement asset is reduced at the time of the replacement's purchase. From a balance sheet standpoint, the liability of deferred taxes is essentially unaffected by an asset sale and purchase under a like-kind exchange. The replacement essentially inherits the replaced asset's deferred tax liability. If the replacement also has a deferred tax liability to add to the liability it inherited, like-kind exchange treatment could compound the effect of deferred taxes on realizable value.

The single asset analysis illustrated the relative value of deferred taxes to asset FMV stabilizes when the tax basis of the asset reaches zero. Any asset that is fully depreciated for tax purposes has a corresponding deferred tax liability equal to that asset's fair market value multiplied by the relevant tax rate. Thus, the holding assets until their tax basis is zero results in the maximum deferred tax liability relative to asset FMV obtainable. What is the result of holding assets until their tax basis is zero and then using like-kind exchange to delay payment of the tax?

To illustrate the affect of holding a string of assets until their tax basis is zero, a string of three assets with individual holding periods of eight years is examined over twenty four years. The assets have a $100,000 purchase price and FMV of $48,766 at the end of 8 years of use. Using a deferred tax rate of 35%, the difference been FMV ($48,766) and tax basis ($0) creates a deferred taxes liability of $17,068 ($48,766 x 35%). In this example, where identical assets are held until their tax basis is zero, every future replacement's tax basis will always be lowered by the same amount. Every replacement's tax basis will be lowered by $48,766 leaving a tax basis of $51,234 at the time of purchase.

Figure 5 illustrates the relationship between asset FMV, tax basis and deferred tax liability. The deferred tax liability remains relatively steady after the first replacement asset is purchased at the beginning of year nine. This is due to the consistent distance between the asset FMV and tax basis functions throughout the rest of the combined 24-year holding period. The first asset creates the deferred tax liability with the following two maintaining it.

If an asset is replaced when its tax basis is zero the deferred tax liability will not increase from the end of the replaced assets' holding period to the end of the replacement asset's holding period. The accrued cost (deferred tax liability) of the replaced asset remains on the balance sheet throughout the holding period of the replacement asset.

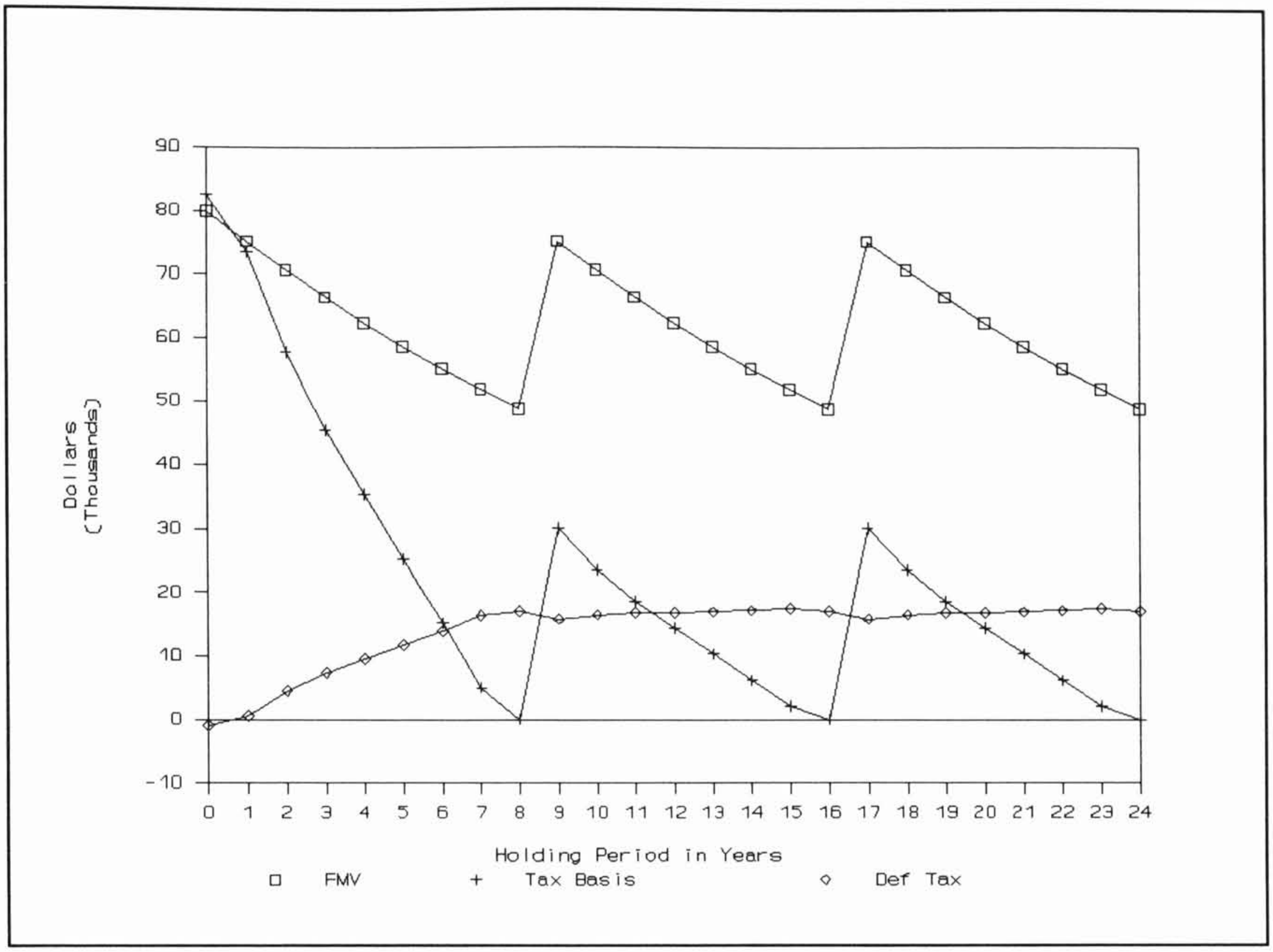

Figure 5. Relationship Between Asset FMV, Tax Basis, & Deferred Tax Liability

However, this liability will not increase over the replacements' holding periods.

Realizable Value With Shorter Holding Periods

In the single asset analysis, it was illustrated shorter holding periods could reduce deferred tax liability without significant cost increases in some cases. These shorter holding periods disposed of assets before they were fully depreciated. Will deferred liability increase over a string of replacements held for shorter periods?

Figure 6 is a plot of the deferred tax liability in Figure 5 and the deferred tax liability generated by a string of six assets held for 4 years each over the same 24-year period. With the 4-year holding periods the deferred tax liability would take longer to accumulate and would never reach as high an amount. However, the difference in the liability is only approximately $500 in year 24. Thus, the benefit of accruing less deferred tax liability by using shorter holding periods is materially eliminated by like-kind exchange treatment.

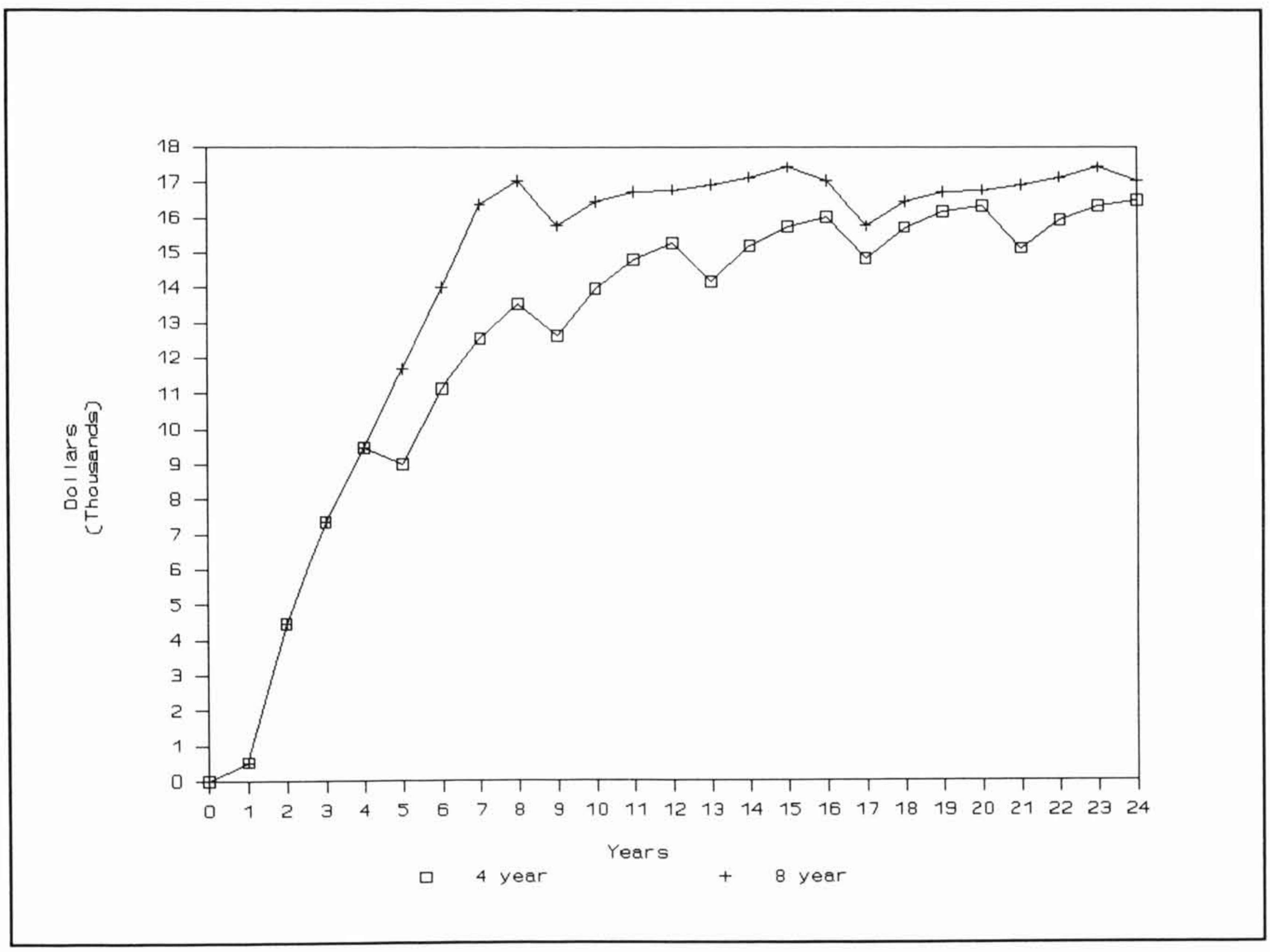

Figure 6. Accumulated Deferred Tax Liability Using 4 and 8 Year Holding Periods

Figure 6 illustrates another important point. In general, two like-kind exchanges will materially maximize deferred tax liability. At the end of year 8, the end of the second individual asset's holding period, the 4-year holding period function is at just under $14,000. At the end of year 24, the end of the sixth assets' holding period, the 4-year holding period function is at approximately $16,000. Thus, even with replacing assets before they are fully depreciated, deferred tax liability is largely maximized in two asset replacements.

Like-kind exchange treatment will not compound the accumulation of accrued asset costs to the balance sheet if assets are held until their tax basis is zero. The costs of replacement assets are fully recognized throughout their holding period. However, the isolation of accumulating accrued costs to the first asset does not result in a lower deferred tax liability. It results in the maximum possible deferred tax liability relative to asset FMV.

Like-kind exchange treatment will compound the accumulation of accrued asset costs to the balance sheet if assets are not held until their tax basis is zero. This can eliminate the deferred tax advantages of holding assets for shorter periods.

Cost vs. Solvency Trade-off

In the individual asset analysis sections of this chapter it was illustrated how a substantial portion of an asset's net discounted cost could be deferred taxes. A like-kind exchange can delay the recognition of this cost beyond the asset's holding period. From a cash flow and discounted cost standpoint, this is beneficial. In exchange for this cost benefit, a liability must be maintained on the balance sheet. This section addresses the long-term aspects of the trade-off between delaying cost recognition and maintaining the liability on the balance sheet.

Theoretically in an infinite string of like-kind exchanges, deferred taxes would never be realized. As long as each asset is replaced when it is sold, the payment of deferred taxes is avoided. Thus, the DT_n (deferred tax) equation could be removed from the overall equation for NDC. However, it is likely that deferred taxes will eventually be recognized at some point.

The cost of deferred taxes in a series of like-kind exchanges should be addressed from a long-term perspective. Consider the annualized cost of the a string of replacements used in Figure 5. Example 3 shows the cost of a one asset holding period of eight years, a two asset holding period of sixteen years, and a three asset holding period of 24 years.

As can be seen in Example 3, deferred taxes relative significance to net discounted cost (NDC) becomes less significant over a series of identical replacements. At the end of the 24-year holding period deferred taxes only contribute \$5,056 to a total discounted cost of the three assets of \$104,349. This is due to the same deferred tax amount is discounted by more and more time periods to reach time equals zero in the discounted cost equation. Thus, in a string of replacements, like-kind exchange treatment does not defer a significant portion of the assets' total cost.

Example 3:

	One asset: n=8yrs	Two: n=16	Three: n=24
MC_n =	11,003	18,337	23,227
VL_n =	67,492	112,543	142,575
DD_n =	(41,977)	(56,697)	(66,509)
DT_n =	11,378	7,585	5,056
NDC_n =	47,896	81,768	104,349
Annualized $Cost_n$ =	7,471	7,653	7,710
DT_n % of NDC_n =	24%	9%	5%
DT_n % of FMV_n =	35%	35%	35%

However, the balance sheet importance of deferred taxes does not diminish in the same manner as the discounted cost considerations. Figure 7 illustrates the relative percentages of deferred taxes to net discounted costs and asset FMV over the combined 24-year holding period of the three identical assets in Example 3. The relative importance of deferred taxes in terms of NDC declines over the 24-year holding period while deferred taxes as a percent of FMV exhibit the same pattern each replacement. Deferred taxes reduce the net realizable value of each replacement by 35%.

Like-kind exchange treatment provides a cost benefit in

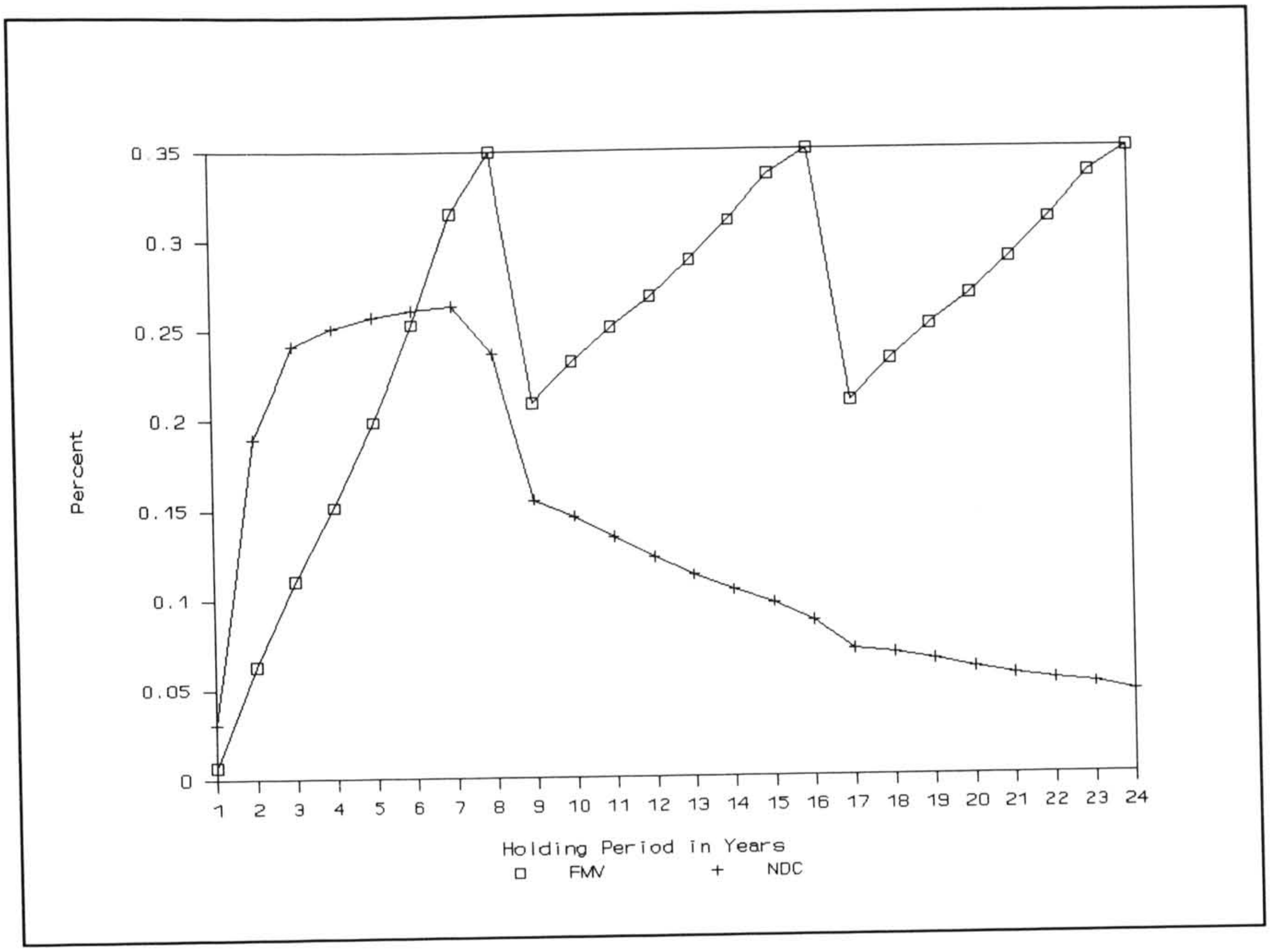

Figure 7. Deferred Taxes as a Percentage of Net Discounted Cost and Asset Fair Market Value

terms of delaying recognition of a portion of an asset's cost. In exchange for this cost benefit, a liability must be maintained. From a long-term perspective, the cost benefit fades as the length of the overall holding period increases. However, the reduced solvency created by maintaining deferred taxes on the balance sheet does not lose its significance.

<u>Cost Benefit vs. Loss of Future Depreciation Deductions</u>

The previous section examined solvency considerations versus the cost benefit of delayed payment of deferred taxes.

The question addressed in this section, is there a cost benefit in the first place. Like-kind exchange treatment affects the cost of the replaced asset and the replacements. The payment of the replaced asset's deferred taxes is delayed, but at the expense of reducing the future tax depreciation deductions (future tax benefits) that can be generated by the replacement.

Patrick's (1991) analysis of like-kind exchange concluded that in general, if future depreciation deductions would be used to offset income and self employment taxes, like-kind exchange treatment increases overall asset costs. The discounted cost calculations used for the example assets in this chapter include offsetting self employment taxes in the value of depreciation deductions. All deferred tax considerations are assumed to not be subject to self employment taxes.

In Example 3 the annualized costs for the holding periods of 8, 16, and 24 years are $7,471, $7,653, and $7,710 respectively. If deferred taxes are recognized at the end of the first asset's holding period, the asset has an annualized cost of $7,471. If recognized at the end of the second asset's holding period, the two assets have an annualized cost of $7,653. If the second asset had a full tax basis to depreciate its annualized cost would be $7,471.

The increase in annualized cost over the succession of the three assets in this example using like-kind exchange treatment appears to agree with the Patrick's analysis. The benefit of not recognizing the deferred taxes on each asset's sale is more than offset by the loss of future tax depreciation deductions from the replacements. The annualized cost for each asset and combined 24-year holding period of the three assets would be $7,471 if like-kind exchange treatment was not used. With like-kind treatment the cost of the combined 24-year holding period is $7,710.

If annualized costs are increasing with each asset, will they continue to increase? Figure 8 illustrates the annualized cost for the Example 3 assets for all holding periods 3 thru 24 years. The annualized cost is calculated for a continuous holding period. For example, if the second asset was sold in year 11 (the third year of its life) the annualized cost to the firm of the two assets over the 11 years is approximately $8,600. Annualized cost sharply increases in the year of each trade due to the large amount of first year loss in FMV dictated by the ASAE formulas.

Figure 8 illustrates annualized cost over the string of replacements. The reduction in depreciation deductions increases overall asset cost over the combined holding period of the three assets. However, the reduction in deductions becomes less significant over time. The increase in annualized cost between the second and third asset is not as large as the increase between the first and second asset. The annualized cost function for an infinite series of

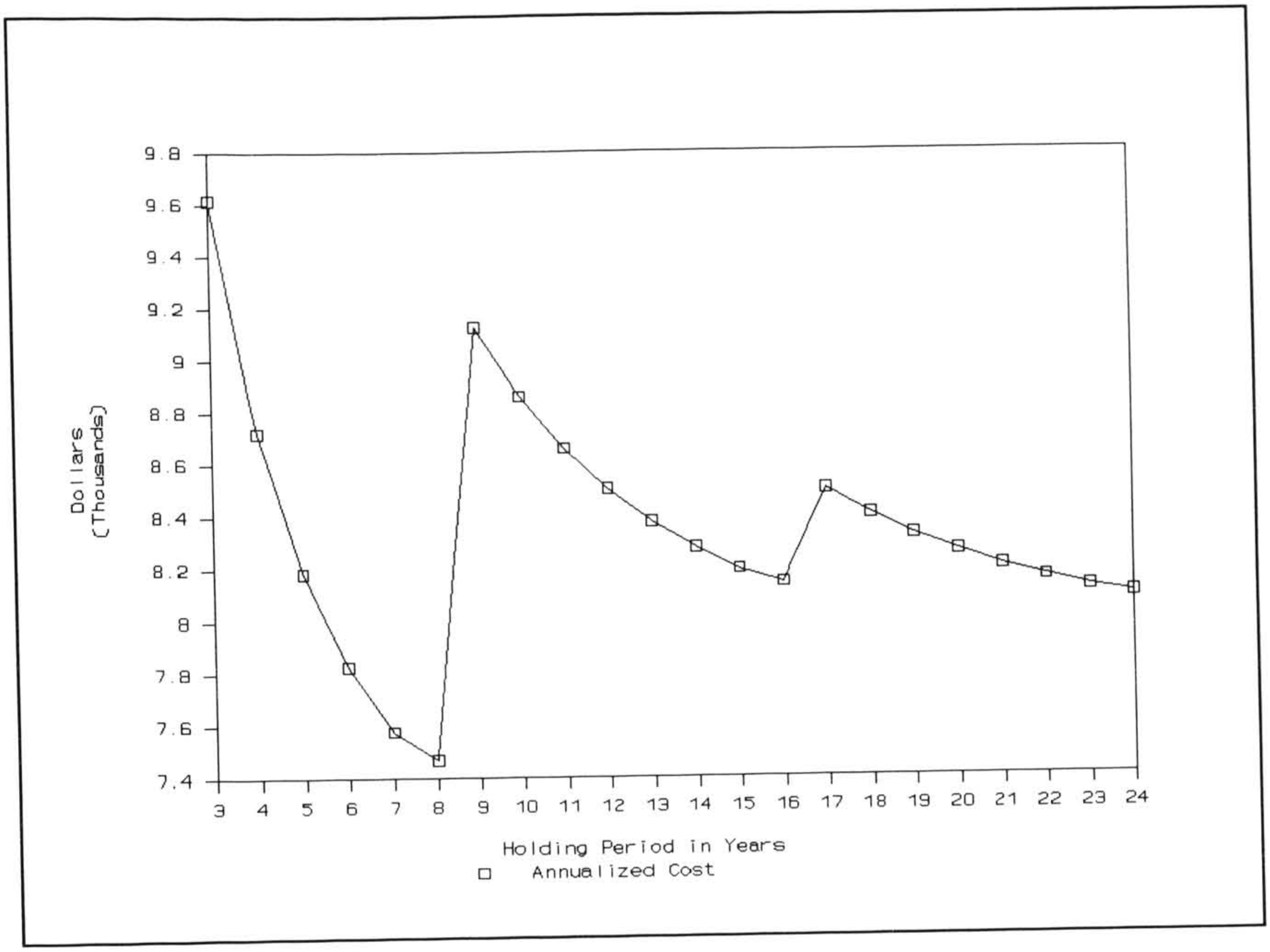

Figure 8. Assets' Overall Annualized Cost

replacements under like-kind exchange treatment does not have an absolute maximum. However, it approaches its relative maximum after a short number of assets. An infinite string of replacement assets identical to the assets in Example 3 would have an annualized cost of approximately $7,800.

Summary

Like-kind exchange treatment will not increase the effect of deferred taxes on asset realizable value if assets are held until fully depreciated. However, if assets are not held until fully depreciated deferred taxes relative to FMV will increase with like-kind exchange treatment. This can eliminate the advantage of shorter holding periods reducing deferred tax liability on the balance sheet.

Like-kind exchange treatment allows recognition of deferred taxes to be delayed by maintaining a liability on the balance sheet. The cost benefits of delaying deferred tax recognition fades over a string of replacements. The liability on the balance sheet does not. Thus, the value of the cost benefit becomes smaller compared to solvency considerations in the long-term.

Analysis of the example assets in this chapter and other analysis using the model designed for this research support Patrick's conclusions on the overall asset cost increases associated with like-kind exchange. The discounted value of delaying deferred tax recognition is generally more than offset by discounted loss in future depreciation deductions when self employment taxes are considered. This chapter adds to Patrick's cost conclusions by addressing the solvency issues of like-kind exchange.

CHAPTER V

WHOLE-FIRM ANALYSIS

Chapter IV addresses deferred taxes in terms of a specific asset's discounted cost and fair market value. This chapter addresses deferred taxes in a whole-firm context. The deferred taxes related to a firm's full complement of depreciable capital investments are considered in the framework of complete financial statements.

Specifically, the following analysis examines the effect of asset holding periods on a firm's total deferred tax liability with and without like-kind exchange treatment. This will allow comparisons to be made between holding periods and the use and non-use of like-kind exchange treatment.

Base Example Firm

The example firm is designed to illustrate how the solvency of a firm is affected by deferred taxes related to different depreciable capital replacement strategies. A single base firm example is used with different capital replacement strategies. The financial statements and assumptions are kept as simple as possible to focus on deferred taxes and particularly their effect on firm solvency.

Further, the example firm's asset values, non-deferred tax liability, before-tax income and before-tax cash flow are held constant to focus on the changes in deferred tax liability.

In chapter IV is was shown that for individual asset investment decisions, deferred taxes are more important in net discounted cost calculations when high tax rates and/or low discount rates are involved. High tax rates and low discount rates lower the asset's net discounted costs and encourage investment. Thus, the example firm will be shown with access to relatively low interest rate financing and subject to high tax rates. The example firm is assumed to be a large crop farm consisting of totally rented land. Total assets consist of a large machinery complement and current assets.

Base Machinery Complement

The machinery complement system of the microcomputer based model generates the yearly fair market value (FMV) tax basis, and yearly tax deductions for the firm's machinery complement. The central assumption in the machinery complement system is that an equal dollar value of depreciable assets (investment in a set of machinery) is purchased each year.

The example farm's beginning (year 1) machinery complement was purchased over the past 5 years in even dollar amounts. The firm manager determined that five years is the optimal holding period for the farm's machinery and plans to trade one fifth of the machinery complement each year for exact replacements. Initially is it assumed all gain on the sale of machinery is recognized at the time of the asset sale/replacement.

Straight-line FMV depreciation is calculated yearly based on the FMV of the machinery sets at the time of sale/replacement. FMV at sale/replacement is an assumed percentage of purchase price based on equation 12. The base complement is assumed to have 60% of purchase price remaining at the end of five years. 60% of purchase price is approximately equal to the value that would be determined by equation 12 at five years of age. This results in a $30,000 ($75,000 - $45,000) loss in value over 5 years, or $6,000 per year. Each year a new $75,000 set of equipment is purchased and the $30,000 difference between cost of the new set and trade-in value of the old set is financed.

In this base complement, like-kind exchange is not involved. Each new machinery set will have a full tax basis to generate tax deductions. Each set will have the same depreciation deductions and tax basis at a particular age. Thus, the tax calculations only need to be made once.

Table IV lists the yearly tax depreciation deductions and tax basis for $75,000 annual sets of machinery. Each set is purchased for $75,000 and $17,500 in code section 179 expense is taken in the first year lowering the depreciable basis to $57,500. The tax depreciation for each year except year one is the depreciable basis multiplied by the depreciation factor. Year one tax depreciation is the depreciable basis multiplied by the factor plus the $17,500 in instant expense.

Table IV

YEARLY TAX CALCULATION FOR EACH MACHINERY SET IN THE BASE COMPLEMENT

Yearly machinery purchase	75,000
Gain rolled in	0
179 instant expense	17,500
Depreciable basis	57,500

Year	Tax Depr Factors	Tax Depr	Tax basis
1	0.1071	23,658	51,342
2	0.1913	11,000	40,342
3	0.1503	8,642	31,700
4	0.1225	7,044	24,656
5	0.1225	7,044	17,612
6	0.1225	7,044	10,569
7	0.1225	7,044	3,525
8	0.0613	3,525	0

Using the figures from Table IV, each machinery set will have a depreciation deduction of $11,000 in the second year of its holding period and have a tax basis of $40,342 at the end of the second year. In this base example, each set has a holding period of 5 years. It is assumed each set is sold at the beginning of year 6 (i.e. January 1). The half-year convention provision in the Internal Revenue Code allows a half-year of depreciation in the year of asset disposal. Thus, the replaced set has a depreciation deduction of $7,044 x 50% or $3,522 in the year of disposal. The half-year convention results in each set having six yearly depreciation deductions even though each set is only held for 5 years.

The sale of each set of machinery results in a taxable gain of $30,910. The tax basis for each machinery set at the time of replacement is $14,090 ($17,612 - $3,522). This is the year 5 tax basis less the half-year of depreciation allowed in year 6. With a FMV of $45,000 the gain on sale of each set is $30,910 ($45,000 - $14,090). The gain on sale is included in the firm's yearly tax expense calculations as a taxable gain.

The combined FMV and tax basises of the 5 sets of machinery making up the machinery complement in this first base example will not change from year to year. The machinery complement consists of 5 sets ranging from 1 to 5 years of age. Each year the oldest set in the complement will be replaced and the taxable gain on sale recognized. A new set will added to the complement and the other 4 sets will be one year older. There is no effect on the combined FMV and tax basis of the complement.

The combined yearly depreciation deduction for the complement will be the same from simulation year 2 forward (Years of the firm simulation should not be confused with year of asset life). In year 1 of the firm simulation, no machinery set is replaced. At the beginning of year 2, and every year thereafter, the oldest machinery set is replaced.

Thus, the depreciation deduction in year 2 and every year thereafter has the additional half-year of depreciation that is not included in year 1. However, a taxable gain on sale is also realized starting in year 2 and every year thereafter.

The base machinery complement's FMV, tax basis, difference between FMV and tax basis, and total depreciation deduction for year 1 is listed in Table V. The depreciation deduction in year 2 and thereafter is $60,910 ($57,388 + $3,522).

Table V

FIVE YEAR HOLDING PERIOD MACHINERY COMPLEMENT

Age	FMV	Tax basis	Diff	Tax depr
1	69,000	51,342	17,658	23,658
2	63,000	40,342	22,658	11,000
3	57,000	31,700	25,300	8,642
4	51,000	24,656	26,344	7,044
5	45,000	17,612	27,388	7,044
	--------	--------	--------	--------
	285,000	165,652	119,348	57,388

Base Financial Statements

The financial statements and assumptions are kept as simple as possible to focus on deferred taxes. Asset values, non-deferred tax liability, before-tax income and before-tax cash flow are held constant to focus on the changes in deferred tax liability. Total asset value is held constant by assuming all after-tax cash flow is withdrawn for consumption instead of used for reinvestment. Machinery debt, the only non-deferred tax liability, is held constant by the assumption that new machinery debt each year is exactly offset by principal payments.

Building on Table V and the assumption the crop farm consists of all rented land, the end of year 1 balance sheet is as follows:

BALANCE SHEET:	
Current Assets	30,000
Machinery	285,000
Land	-0-

Total Assets	315,000
Machinery Debt	120,000
Deferred Taxes	41,772

Total Liabilities	161,772
Equity	153,228
Debt-to-Asset ratio	0.51
without deferred tax	0.38
Def tax to Assets ratio	0.13
Deferred tax rate	35%

The balance sheet is calculated as follows. Current assets, and machinery debt are exogenous variables. The yearly machinery values are generated by the machinery complement system of the model. All deferred tax liability on the balance sheet is the result the machinery complement. Deferred taxes of other assets are not considered. The yearly deferred tax liability is determined by the difference between asset FMV and tax basis multiplied by the deferred tax rate. Equity is intentionally calculated from the difference between total assets less total liabilities.

The income statement for year 1 is as follows:

INCOME STATEMENT:	
Net farm income before interest, FMV depreciation & taxes	63,000
Interest expense	6,000
FMV depreciation	30,000

Net income before tax	27,000
Tax expense	(194)

Net income after tax	27,194
Tax expense:	
Net income before depreciation	57,000
Tax depreciation	57,388

Taxable farm income	(388)
Taxable gain	-0-
Tax expense	(194)

Income is based on a percentage return on farm assets. Net farm income before interest, FMV depreciation and taxes ($63,000 in year 1) is calculated from the yearly total assets and an exogenous return on assets variable. Interest expense is calculated from an exogenous interest rate variable multiplied by the amount of machinery debt on the balance sheet. Fair market value depreciation is determined endogenously by the machinery complement system.

In this example, the firm generates a 20% return to asset before FMV depreciation. This results in income after depreciation of $33,000 per year before interest and taxes. With depreciation included the return on assets is approximately 10%. The firm's machinery debt is subject to a 5% rate of interest.

Taxable income is calculated from net farm income before FMV depreciation and taxes, and the tax depreciation deductions generated by the machinery complement system. Taxable gain is also generated by the machinery complement system. Taxable income is multiplied by an exogenous tax rate variable and taxable gain is multiplied by an exogenous deferred tax rate variable. The tax on taxable income and taxable gain are combined to determine tax expense. In this first year, taxable income is slightly negative. It is assumed the farm loss offsets other income and thus the farm loss creates tax income instead of tax expense.

Year 1 cash flow is as follows:

CASH FLOW:	
Net farm income before int, FMV depr & tax	63,000
Interest payments	(6,000)
Tax payments	194
Loan principal payments	(30,000)
New machinery loans	30,000
Machinery purchases	(75,000)
Machinery sale	45,000

After-tax cash flow	27,194

The income tax rate in this is example is assumed to be 50% with the deferred tax rate at 35%. While a 50% tax rate may seem extreme at first, it is not improbable. If a manager, through other enterprises and/or spousal income, had other income to completely fill the 15% federal tax bracket all additional income would be taxed at 28% and 31%. 50% can be obtained by summing a 28% federal tax rate, 15% self-employment rate, and a 7% state rate. The deferred tax rate in this example is 15% lower as the taxable gains on machinery sales are not subject to self-employment taxes.

Interest and tax payments in the after-tax cash flow calculations are the same as the expenses for these items. Cash payments on machinery loans are equal to new machinery loan cash inflows in accordance with holding the machinery debt liability constant on the balance sheet from year to year.

Complete Base Example

With the base financial statements and beginning machinery complement complete, the effects of asset replacement and deferred taxes can be examined. In this illustration, without like-kind exchange treatment all of the financial statements after year 1 will be exactly the same. Abbreviated financial statements for years 1 and 2 are presented in Table VI.

At the end of year 1, the firm has acquired a deferred tax liability of $41,772 on its machinery complement. Not all of this liability was accumulated in year 1. It was acquired over the previous 4 years and year 1 while the base complement was being assembled. The firm has essentially $41,772 in accrued machinery costs on the balance sheet.

Table VI

FIVE YEAR HOLDING PERIOD FINANCIAL STATEMENTS

YEAR	1	2
BALANCE SHEET:		
Current Assets	30,000	30,000
Machinery	285,000	285,000
	-------	--------
Total Assets	315,000	315,000
Machinery Debt	120,000	120,000
Deferred Taxes	41,772	41,722
	-------	-------
Total Liabilities	161,772	161,772
Equity	153,228	153,228
Debt to Asset ratio	0.51	0.51
without deferred tax	0.38	0.38
Def tax to Assets ratio	0.13	0.13
INCOME STATEMENT:		
NFI before tax	27,000	27,000
Tax expense	(194)	8,864
	-------	-------
Net income after tax	27,194	18,136
Tax expense:		
NFI before depreciation	57,000	57,000
Tax depreciation	57,388	60,910
	------	------
Taxable farm income	(388)	(3,910)
Taxable gain	-0-	30,910
Tax expense	(194)	8,864
CASH FLOW:		
NFI before depreciation	57,000	57,000
Tax payments	194	(8,864)
Net other flows	(30,000)	(30,000)
	-------	--------
After-tax cash flow	27,194	18,136

In this base illustration where the exact same machinery complement is maintained from year to year this liability will remain constant. Unless the firm liquidates completely or stops the yearly replacement of the assets, the same dollar value of liability will always remain on the balance sheet.

Starting in year 2, the oldest asset in the complement is replaced and a taxable gain of $30,910 is recognized on sale. Farm taxable income shows an even bigger loss in year 2 due to the addition half-year of depreciation. However, the taxable gain makes the overall tax expense positive. The tax expense for year 2 is $8,864 ($30,910 x 35% less $3,910 x 50%). Once the cost of deferred taxes is no longer being accumulated and the deferred tax on the first asset replaced is recognized, tax expense increased by over $9,000. This has a corresponding reduction on after-tax income and cash flow of over $9,000.

Table VI illustrates the importance of accrual income measures when measuring financial performance. The net income after-tax in years 1 and 2 is $27,194 and $18,136 respectively. These income figures are based on a cash tax expense. If the accrued deferred tax liability accumulated from the beginning to the end of year 1 is considered, the income figures would be $18,136 for both years.

Although it is not directly tied to this analysis, another point about deferred taxes distortion of income measures can be made from Table VI. Research and analysis often uses farm income figures taken from the schedule F tax form because this is the only farm income data available. In Table VI a $3,910 loss would be reported on schedule F as farm income in year 2. The $30,910 gain, the recognized deferred taxes, would be reported as other income on the front of form 1040. Thus, use of schedule F farm income as a measure of financial performance would be very misleading in this situation.

Holding Period Analysis

With base financial statements and assumptions complete, comparison can be made between different length holding periods from a whole-firm perspective. The comparison is made with holding periods of 5, 8, and 10 years. The primary difference between these three holding period is the depreciable basis of the assets. Assets that are 7-year property in the context of the Internal Revenue Code (IRC) are fully depreciated in the eighth year. The half-year convention spreads the deductions over eight years. Thus, the 5-year holding period trades the assets before they are fully depreciated, the 8-year in the year they are fully depreciated, and the 10-year is two years after full depreciation.

Machinery Complement Modifications

The modifications to the base calculation in Table V required to analyze the 8- and 10-year holding periods are largely changes to the machinery complement. The first of these changes is to dollar amount of the annual machinery purchase. With a 5-year holding period $75,000 was the annual purchase with a five year life giving the machinery complement a total purchase price of $375,000 ($75,000 x 5). An annual purchase of $46,875 with an eight-year asset life gives the machinery complement the same total purchase price of $375,000. With the 10-year holding period, the annual purchase is $37,500 ($375,000 / 10 years).

The value of the assets at the time of sale/replacement must also be adjusted. Equation 12 gives an asset value of approximately 60% of purchase price after five years. The approximate percentage for 8 and 10 years is 50% and 43% respectively. Thus, the value of the equipment sets at the end of year eight is $23,438 ($46,875 x 50%).

The annual machinery debt payments equal annual borrowing for all three holding periods. The longer holding periods have smaller annual purchases and thus would likely have smaller borrowing requirements. Thus, machinery debt is adjusted down in accordance with asset values. The machinery debt is adjusted to maintain a 0.38 debt to asset ratio when deferred taxes are not considered for each of the three periods analyzed.

The machinery complements for the 8- and 10-year holding periods are listed in Tables VII and VIII.

Table VII

EIGHT-YEAR HOLDING PERIOD MACHINERY COMPLEMENT

Age	FMV	Tax basis	Diff	Tax depr
1	43,945	26,229	17,716	20,646
2	41,016	20,610	20,406	5,619
3	38,086	16,194	21,892	4,415
4	35,156	12,596	22,560	3,598
5	32,227	8,998	23,229	3,598
6	29,297	5,399	23,898	3,598
7	26,367	1,801	24,567	3,598
8	23,438	0	23,438	1,801
	--------	--------	--------	--------
	269,531	91,826	177,705	46,875

Table VIII

TEN-YEAR HOLDING PERIOD MACHINERY COMPLEMENT

Age	FMV	Tax basis	Diff	Tax depr
1	35,363	17,858	17,505	19,642
2	33,225	14,032	19,193	3,826
3	31,088	11,026	20,062	3,006
4	28,950	8,575	20,374	2,450
5	26,813	6,126	20,687	2,450
6	24,675	3,676	20,999	2,450
7	22,538	1,226	21,312	2,450
8	20,400	0	20,400	1,226
9	18,263	0	18,263	0
10	16,125	0	16,125	0
	--------	--------	--------	--------
	257,438	62,520	194,918	37,500

Holding Period Comparison

Net farm income before interest, FMV depreciation, and taxes in the whole-firm model is based on a percentage return to assets. The same return on assets percentage is used for the 5-, 8-, and 10-year holding periods. This results in a slightly lower income for the longer holding periods because less asset value is maintained on the balance sheet. However, it is reasonable to assume the longer holding periods would result in higher operating and maintenance costs because of the higher average age of the assets. Thus, the lower income estimate for longer holding periods adds to logical comparison of the different holding periods.

The 5-, 8-, and 10-year holding periods are compared in Table IX. Table IX presents the influence of the four cost components used in the individual asset analysis from a whole-firm perspective. Recall the four components are loss in FMV, maintenance and operating costs, tax benefits (deductions), and tax on the sale of assets (deferred taxes). An 8-year holding period results in the highest net farm income after tax for the example firm. The 5-year holding period has the largest tax benefits (deductions), but the highest FMV depreciation. The 10-year holding period has the lowest FMV depreciation, but the lowest tax benefits as well. In terms of after-tax income the 8-year period is the best compromise between FMV depreciation and tax benefits.

Table IX

FINANCIAL STATEMENTS FOR FIVE, EIGHT, AND TEN-YEAR HOLDING PERIODS

Holding Period	5-year	8-year	10-year
BALANCE SHEET:			
Current Assets	30,000	30,000	30,000
Machinery	285,000	269,531	257,438
Total Assets	315,000	299,531	287,438
Machinery Debt	120,000	115,000	110,000
Deferred Taxes	41,772	62,197	68,221
Total Liabilities	161,772	177,196	178,221
Equity	153,228	122,336	109,216
Debt to Asset ratio	0.51	0.59	0.62
without deferred tax	0.38	0.38	0.38
Def tax to Assets ratio	0.13	0.21	0.24
INCOME STATEMENT:			
FMV depreciation	30,000	23,438	21,375
NFI before tax	27,000	30,719	30,613
Tax expense	8,864	11,844	12,888
NFI after tax	18,136	18,875	17,725
Tax expense:			
NFI before depreciation	57,000	54,156	51,988
Tax depreciation	60,910	46,875	37,500
Taxable income	(3,910)	7,281	14,488
Taxable gain	30,910	23,438	16,125
Tax expense	8,864	11,844	12,888
CASH FLOW:			
NFI before depreciation	57,000	54,156	51,988
Tax payments	(8,864)	(11,844)	(12,888)
Machinery purchase	(75,000)	(46,875)	(37,500)
Net other flows	45,000	23,437	16,125
After-tax cash flow	18,136	18,875	17,725

Annual after-tax income and cash flow are the highest under the 8-year holding period. Compared to the 5-year holding period, the 8-year period creates $739 of additional after-tax income and cash flow per year. However, after-tax income and cash flow are not affected by the additional deferred tax liability the 8-year period accrues. The 8-year period accrues more than $20,000 of asset cost to the balance sheet compared to the 5-year period.

The future value of an annual annuity of $739 compounded at the firm's 10% rate of return to assets for 14 years has a future value of $20,674. It would take approximately 14 years of the additional income to outweigh the additional deferred tax liability. If the firm for some reason, voluntary or not, decided to recognize this liability before 14 years, the 8-year period would not be the lower cost option between the 8- and 5-year periods. Thus, after-tax income without the consideration of deferred tax liability is not always the best measure of investment profitability (cost).

This example illustrates the importance of accrual income measures. Deferred tax liability accrues asset costs to the balance sheet that taxable income and cash flow measures do not reflect. Thus, the income considerations of deferred taxes should be considered in all complete financial analysis, not just in the firm examples presented here.

In addition to income considerations, deferred taxes affect risk. The firm example above illustrates how deferred taxes related to depreciable capital investments can significantly increase debt-to-asset ratio. With all three holding periods presented in Table IX, the debt-to-asset ratio of the firm is 0.38 if deferred taxes are not considered. The deferred taxes related to the machinery complement increase the ratio to over 0.5 in all three holding periods. Debt-to-asset ratio is an important measure of risk.

The Farm Financial Standards Task Force (1991) offers the following interpretation of debt-to-asset ratio. "This ratio measures financial position. The debt/asset ratio compares total farm obligations owed against the value of total farm assets. This ratio is one way to express the risk exposure of the farm business. It can be calculated using either the cost or market value approach to value farm assets. If the market value approach is used to value farm assets, then deferred taxes on the assets should be included as liabilities. The higher the ratio, the more risk exposure of the farm business."

Holding periods can affect deferred taxes impact on firms' risk. In Table IX the 5-year holding period has the lowest debt-to-asset ratio and thus, the lowest risk. The 8-year holding period increases deferred tax liability related to the machinery complement by approximately $20,000 over the 5-year holding period. This increases the example firm's debt-to- asset ratio by 8 points (0.59 - 0.51).

There are no universal objective standards on acceptable ratio levels. However, there are generally common ranges preferred or considered acceptable within industries. Knorr (1994) discusses a 1992 study of the U.S. Comptroller of the Currency that asked agricultural banks what standards they used when judging loans. Part of the Comptroller's report considered ratios agricultural banks used and what the acceptable and desired levels they considered for these ratios. The acceptable and desired level for total debt to total assets was 0.60 and 0.40 respectively. The levels published by Knorr were the median of farm banks who reported to the survey.

In Table IX the debt to asset ratio is 0.38 for all three holding periods if deferred taxes are not considered. Deferred taxes increase all three holding period's debt to asset ratios beyond the 0.40 and lower desired range reported in the Comptroller's survey. The 8-year periods debt-to-asset ratio of 0.59 is just within the acceptable range of 0.60 and lower. The 5-year period, with a debt to asset ratio of 0.51, would be well within the acceptable range.

Given the risk (solvency) advantage of the 5-year period compared to small if any cost advantage of the 8-year period, it is likely most managers would choose the 5-year holding period framed in this context. A lender keen on deferred taxes would most likely prefer the financial results of the 5-year holding period as well.

Summary

Chapter IV illustrates how the deferred taxes related to a single asset can be reduced by a shorter holding period, in some cases, without significant cost increases. The holding period analysis in this section illustrates the same concept from a whole-firm perspective. Shorter holding periods result in lower deferred tax liabilities.

This section also addresses how deferred taxes can materially affect a firm's risk. The deferred taxes related to depreciable capital investments can substantially affect a firm's financial measures such as debt-to-ratio.

The issue of deferred taxes and income measures is also addressed in this section. Deferred tax liability accrues asset costs to the balance sheet that taxable income and cash flow measures do not reflect. Thus, the accrued costs of deferred taxes should be considered in complete financial analysis. The potential of recognizing the accrued costs of deferred taxes can be important in accessing the cost benefits of a longer holding period.

Like-Kind Exchange Analysis

Now that some basic conclusions about deferred taxes from a whole-firm perspective have been made, the more specific issue of deferred taxes and like-kind exchange treatment can be addressed. Analysis of like-kind exchange treatment starts with the same base firm and machinery complement. A five-year holding period is used for the machinery complement and the beginning (year 1) financial statements are the same as the year 1 statements in Table VI. This will allow for comparisons to be made between the firm results with and without like-kind exchange treatment.

Machinery Complement Calculations

In the whole-firm analysis presented so far, the tax basis and depreciation deductions of the machinery complement remained constant from year to year. When the consideration of like-kind exchanges is added, tax basis and depreciation deductions can no longer be held constant. The tax calculations related to the machinery complement must be expanded.

The five sets of machinery in the beginning complement are referred to as the base series in the remaining illustrations. The machinery sets that directly replace the base series sets are referred to as the first replacement series. The sale of each set of machinery in the base series results in a taxable gain of $30,910. This gain reduces the tax basis of each set in the first series of replacements. The yearly tax depreciation deductions and tax basis for the first series of replacements is listed in Table X.

Table X

YEARLY TAX CALCULATIONS FOR THE FIRST SERIES OF REPLACEMENTS

Machinery purchase	75,000
Gain rolled in	30,910
179 instant expense	17,500
Depreciable basis	26,590

Year	Tax Depr Factors	Tax Depr	Tax basis
1	0.1071	20,348	23,743
2	0.1913	5,087	18,656
3	0.1503	3,997	14,659
4	0.1225	3,257	11,402
5	0.1225	3,257	8,145
6	0.1225	3,257	4,887
7	0.1225	3,257	1,630
8	0.0613	1,630	0

As in the examples without like-kind exchange, machinery replacement starts in year 2. At the beginning of year 2, the oldest set in the base series is replaced by the first set of the first series of replacements. At the end of year two, the machinery complement consists of four sets of the base series and one of the first replacement series sets. Table XI lists the complement's FMV, tax basis, and depreciation deduction for year 2. The first replacement set (age 1) has almost the smallest tax basis of the 5 sets in the complement. Tax depreciation in year 2 includes the half-year of depreciation on the base series set traded at the first of the year.

Table XI

END OF YEAR 2 MACHINERY COMPLEMENT

Age	FMV	Tax basis	Diff	Tax depr
1	69,000	23,743	45,257	20,348
2	63,000	40,342	22,658	11,000
3	57,000	31,700	25,300	8,642
4	51,000	24,656	26,344	7,044
5	45,000	17,612	27,388	7,044
6	----	----	----	3,522
	285,000	138,053	146,947	57,599

At the end of year six the complete base series is replaced and the machinery complement consists entirely of the first replacement series sets. Beginning in year 7, the oldest set of the first replacement series is replaced the first set of the second replacement series. The gain on each set in the first series of replacements will reduce the depreciable basis of the second series by $38,484. Table XII illustrates the tax depreciation and tax basis calculation for the second series of replacements.

Table XII

YEARLY TAX CALCULATIONS FOR
THE SECOND SERIES OF REPLACEMENTS

Machinery purchase	75,000
Gain rolled in	38,484
179 instant expense	17,500
Depreciable basis	19,016

Year	Tax Depr Factors	Tax Depr	Tax basis
1	0.1071	19,537	16,979
2	0.1913	3,638	13,342
3	0.1503	2,858	10,484
4	0.1225	2,329	8,154
5	0.1225	2,329	5,825
6	0.1225	2,329	3,495
7	0.1225	2,329	1,166
8	0.0613	1,166	0

Table XIV is a listing of the machinery complement when it consists entirely of the second series of replacements. The difference between the FMV and tax basis of machinery complement in year 11 (Table XIV) is $230,217. The differences in year 1 and year 6 are $119,348 (Table V) and $208,396 (Table XIII) respectively. The difference increased more between year 1 and 6 than from year 6 to 11. Recall that when assets are not held until their tax basis is zero before replacement, there is no absolute maximum to deferred tax liability. However, generally deferred tax liability is maximized with two like-kind exchanges. If the calculations in the example were expanded to include 10 complete replacements of the machinery complement, the difference between FMV and tax basis would be approximately $237,000. Roughly a $7,000 increase from the difference after 2 series of replacements. Thus, deferred taxes are materially maximized by the two complete replacements of the machinery complement.

Table XIII

END OF YEAR 6 MACHINERY COMPLEMENT

Age	FMV	Tax basis	Diff	Tax depr
1	69,000	23,743	45,257	20,348
2	63,000	18,656	44,344	5,087
3	57,000	14,659	42,341	3,997
4	51,000	11,402	39,598	3,257
5	45,000	8,145	36,855	3,257
6	----	----	----	3,522
	285,000	76,604	208,396	39,468

Table XIV

END OF YEAR 11 MACHINERY COMPLEMENT

Age	FMV	Tax basis	Diff	Tax depr
1	69,000	16,979	52,021	19,537
2	63,000	13,342	49,658	3,638
3	57,000	10,484	46,516	2,858
4	51,000	8,154	42,846	2,329
5	45,000	5,825	39,175	2,329
6	----	----	----	1,629
	285,000	54,783	230,217	32,320

Complete Like-Kind Financial Statements

With the calculation for the machinery complement with like-kind exchange treatment complete, the firm's financial statements can again be completed. Table XV illustrates selected financial information for the base firm for years 1, 6, and 11. The year 1 column in Table XV is identical to the year 1 column in Table VI.

The selected financial information for years 1, 6, and 11 illustrates the increasing importance of deferred taxes. If deferred taxes are ignored, solvency remains the same over the analysis period. However, the firm's equity is reduced each year by an amount equal to the increase in deferred taxes. Deferred taxes amount to over one fourth of the machinery complement's value in year 11. Further, the firm's debt to asset ratio is increased by 26 points (0.38 - 0.64) by deferred taxes.

Table XV

YEAR 1, 6, AND 11 LIKE-KIND
EXCHANGE FINANCIAL STATEMENTS

YEAR	1	6	11
BALANCE SHEET:			
Current Assets	30,000	30,000	30,000
Machinery	285,000	285,000	285,000
Total Assets	315,000	315,000	315,000
Machinery Debt	120,000	120,000	120,000
Deferred Taxes	41,772	72,939	80,576
Total Liabilities	161,772	192,939	200,576
Equity	153,228	122,061	114,424
Debt to Asset ratio	0.51	0.61	0.64
without deferred tax	0.38	0.38	0.38
Def tax to Assets ratio	0.13	0.23	0.26
INCOME STATEMENT:			
FMV depreciation	30,000	30,000	30,000
NFI before tax	27,000	27,000	27,000
Tax expense	(194)	8,766	12,340
NFI after tax	27,194	18,234	14,660
Tax expense:			
NFI before depreciation	57,000	57,000	57,000
Tax depreciation	57,388	39,468	32,320
Taxable income	(388)	17,532	24,680
Taxable gain	-0-	-0-	-0-
Tax expense	(194)	8,766	12,340
CASH FLOW:			
NFI before depreciation	57,000	57,000	57,000
Tax payments	194	(8,766)	(12,340)
Net other flows	(30,000)	(30,000)	(30,000)
Net cash flow	27,194	18,234	14,660

While before-tax income is constant, the decreasing tax depreciation deductions continue to lower after-tax income over the analysis period. The decreasing deductions have the identical negative effect on after-tax cash flow. While before-tax cash flow is constant, the smaller depreciation deductions reduce after-tax cash flow. The cash flow would not decrease substantially below $14,660 in year 11 if the simulations were continued. This is based on deferred taxes being materially maximized with two complete replacements of the machinery complement. With deferred taxes maximized, the tax basis of future replacements stabilizes and the decline in depreciation deductions ends.

Obviously this is a very specific example. A firm subject to a lower tax rate with assets on the balance sheet in addition to machinery would not be as heavily influenced by the machinery's deferred taxes. However, two generalizations can be made from this example. The relative amount of deferred taxes increases substantially during the transition from a machinery complement purchased with a full tax basis to a second set of replacements. After-tax cash flow can be substantially reduced during this transition primarily because yearly depreciation deductions are reduced.

Summary Comparison

Table XVI presents a comparison between 5- and 8-year holding periods with and without like-kind exchange treatment.

The first two items listed in the table are the example firm's deferred tax liability and debt-to-asset ratio in year 11 under the four different replacement schemes. Like-kind exchange treatment substantially increases the example firm's deferred tax liability. This liability translates into a higher debt-to-asset ratio for the like-kind exchange examples. The 5-year example with like-kind treatment has a debt-to-asset ratio 13 points (0.64 - 0.51) greater than the debt-to-asset ratio of the 5-year example without like-kind treatment.

Table XVI

SUMMARY COMPARISON OF 5 AND 8-YEAR HOLDING PERIODS WITH AND WITHOUT LIKE-KIND EXCHANGE

	Without		With	
Holding Period	5-year	8-year	5-year	8-year
Deferred Taxes	41,722	62,197	80,576	87,840
Debt to Asset	0.51	0.59	0.64	0.68
After-tax income:				
Year 2	18,136	18,875	27,300	25,823
Year 11	18,136	18,875	14,660	15,359
Tax depreciation:				
Year 2	60,910	46,875	57,599	44,365
Year 11	60,910	46,875	32,320	23,437
Tax Expense:				
Year 2	8,864	11,844	(300)	4,896
Year 11	8,864	11,844	12,340	15,360
PV of cash flow:				
Years 2-11	111,438	115,979	123,708	122,782
Years 12-21	111,438	115,979	90,079	94,376

Income, depreciation, and tax expense information is presented in Table XVI for years 2 and 11. In year 1, before asset replacement starts, after tax income is basically the same for all four replacement schemes. The material differences between the replacement schemes start with the first asset replacement in year 2.

The simulations are carried out 11 years to allow the replacement of the complement two complete times in the 5-year holding period like-kind exchange example. In the 8-year like-kind example, the complement only needs to be replaced once because the assets are held until their tax basis is zero. The maximum deferred tax liability is obtained with one series of replacements. The financial information for the 8-year like-kind example is identical for simulation years 9, 10, and 11.

Table XVI illustrates the initial income benefits of like-kind exchange treatment. The like-kind examples have large depreciation deductions in simulation year 2. This translates to low tax expense and high after-tax income. However, the like-kind examples receive more depreciation deductions in the first years of the simulation than in the later years. In year 11, after-tax income is substantially reduced by the lower depreciation deductions.

Table XVI suggests that like-kind exchange treatment results in lower depreciation deductions and higher tax expense in the long-term. In year 11, the examples without like-kind treatment have substantially higher depreciation deductions. Part of the benefit of these deductions is offset by sizable taxable gains on the sale of machinery every year. Nonetheless, the examples without like-kind exchange treatment have the lowest tax expense in year 11, and thus the most benefit from their machinery complements' tax deductions.

The present value of the after-tax cash flows for the four different replacement schemes is listed at the bottom of Table XVI. The after-tax cash flows for years 2 thru 11 and ten, year 11 cash flows are discounted at 10%. The examples with like-kind exchange created the highest net present value over the firm simulation (years 2 thru 11). However, the examples without like-kind exchange would generate the highest net present value over the next 10 years if the simulation were extended to years 12 thru 21.

Like-Kind Exchange Analysis Summary

The results of the example analysis in this section suggest several general conclusions. First, shorter asset holding periods result in lower deferred tax liability. However, like-kind exchange treatment reduces the deferred tax benefits of shorter holding periods. Like-kind exchange treatment results in a substantially higher deferred tax liability when compared to non like-kind exchange treatment. Thus, like-kind exchange treatment will increase firms' risk related to deferred tax liability.

After-tax income and cash flow are increased initially by like-kind exchange treatment. However, both income and cash flow will be reduced substantially in later years. In the long-term the greatest annual cash flows will be generated by non like-kind exchange treatment.

The initially high cash-flows from like-kind treatment could be very misleading and add to a firm's risk. For example, consider if a manager took on additional debt based on the assumption he or she had the yearly after-tax cash flow to service this debt well into the future. The firm could be placed in financial stress in later years without any change in before-tax income or cash flow. Another pitfall could be if a manager based his equity withdrawals from the firm based on the initially high after-tax cash flow. The manager's consumption habits would be substantially changed in later years.

This chapter has that illustrated deferred tax considerations can materially influence a firm's income, cash flow, and equity (solvency). Deferred tax considerations can be important to depreciable capital investment decisions. The illustrations in this chapter show how deferred tax liability can be materially reduced by different investment strategies without materially reducing income.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Most capital investment analysis focuses strictly on cash flows when determining costs and does not consider the full effect of deferred tax liabilities' on the value of the firm or the investment decision. More complete knowledge on the important factors involved in capital investment analysis can be valuable to the individual decision maker. The primary purpose of this study was to address the importance of deferred tax considerations in depreciable capital investment decisions from an individual investment and a whole-firm perspective. Specifically, to address the importance of these considerations for individual firms having certain financial characteristics and management objectives.

Concepts and Requirements

To fulfill this purpose, discounted cash flow analysis concepts, whole-firm analysis concepts, and Internal Revenue Code (IRC) provisions were initially researched and studied. Next, previous research addressing the impact of income tax legislation on capital investment was reviewed. This previous research included individual investment implications as well as whole-firm implications of tax legislation. The focus of previous research was on the influence of tax legislation on investment costs and/or machinery complement selection. Deferred tax considerations, particularly from a balance sheet or solvency aspect, were not specifically addressed.

The study of analysis concepts, previous research, and IRC provisions identified several important requirements for this research. Individual investment (asset) analysis requirements were as follows; 1) discounted cash flow analysis would need to be supplemented with calculating assets' fair market value and deferred tax liability throughout the assets' lives, 2) a range of tax and discount rates should be used in the analysis to address the financial situations of different firms, 3) the concept of optimal holding period, the optimal amount of time to hold an asset, would need to be included, and 4) the issues presented by the IRC provisions related to like-kind exchange treatment would need to incorporated into analysis involving replacement assets.

From a whole-firm perspective, the general requirements were as follows; 1) a complete set of financial statements would be required. More specifically a balance sheet to examine solvency, an income statement to examine profitability, and a cash flow statement to examine feasibility would be required, 2) the deferred taxes related to all the firm's depreciable capital investments should be considered when analyzing the balance sheet as well as other financial statements, and 3) a complete capital replacement strategy over a series of years would need to be integrated with the financial statements to give insight on short- and long-run implications to solvency, income, and cash flow.

With these requirements in mind, two microcomputer based spreadsheet applications were developed. One for individual asset analysis and one for whole-firm analysis. The applications allowed for a range of variables and example scenarios to be estimated.

Results

Individual Asset Analysis

The individual asset analysis was separated into two parts. Analysis of a single asset investment and analysis of asset replacement involving like-kind exchange treatment. The single asset investment analysis addressed the following questions:

> Do deferred taxes substantially reduce the realizable value (fair market value less deferred taxes) of assets on the balance sheet?
>
> Do deferred tax considerations have relevance in optimal holding period decisions?
>
> Do deferred taxes accrue a substantial portion of an asset's cost to the balance sheet and delay payment of those costs until the year of disposal?

Realizable Value It was shown that deferred taxes can significantly reduce the realizable value of assets during the assets' holding period. Deferred taxes are typically considered in discounted cost calculations only at the end of the holding period. Because discounted cost analysis focuses only on costs, the analysis was expanded to consider the solvency aspect of deferred taxes along with cost.

The expanded analysis illustrated that solvency issues should be considered along with cost analysis. A combination of higher tax rates and lower discount rates results in lower net discounted costs. While a high tax rate lowers the investment's cost, it increases the deferred taxes related to that investment. Net discounted cost analysis alone could yield an attractive analysis in terms cost, but analysis of the solvency aspect related to deferred taxes could present important risk considerations. All managers should consider the effect of deferred taxes on realizable values in investment decisions. Even if a manager is not subject to a high tax rate at the time of the initial investment, he or she could be in a high tax bracket in the future.

Optimal Holding Periods It was shown that optimal holding periods defined by lowest annualized cost might not be "optimal" for all managers. Annualized cost was calculated to determine optimal holding periods in terms of lowest annualized cost for the example assets. The deferred tax liability corresponding to the optimal holding periods was calculated as well. The cost curve for the example assets provided an opportunity to reduce deferred tax liability in exchange for a small increase in annualized cost. This certainly does not imply the cost curve of all assets will provide such an opportunity. However, it does suggest the possibility is worth investigating. Further analysis illustrated higher tax rates provide more of an opportunity to reduce deferred tax liability without substantially increasing costs.

Delaying Payment of Costs It was illustrated, given a high tax rate and low discount rate, that a substantial portion of an asset's net discounted cost is deferred taxes. Deferred taxes accrue throughout an asset's holding period and are not fully recognized until the time of the asset's sale. A substantial portion of the asset's cost can be realized at the end of the holding period instead of being allocated over the holding period. From a cash flow and discounted cost standpoint this is beneficial. However, if the increasing accrued cost of deferred taxes and the corresponding liability are ignored during the holding period, a misleading perspective of asset costs can be presented.

Like-kind Exchange Analysis The remainder of the individual asset analysis built on these points in addressing deferred tax considerations with like-kind exchange treatment. The specific points addressed were as follows:

> Do deferred taxes affect the long-term realizable value of a string of replacement assets on the balance sheet? More specifically, do different lengths of individual asset holding periods affect the realizable value of a string of replacement assets on the balance sheet?

Is there an important trade-off between delaying payment of asset costs and solvency?

What are the long-term cost effects of delaying payment of an replaced asset's cost on the cost of replacement assets.

Long-term Realizable Value and Holding Periods The analysis determined if an asset is replaced when its tax basis is zero, deferred tax liability will not increase from the end of the replaced asset's holding period to the end of the replacement asset's holding period. Thus, the long-term realizable value of a string of replacements is not decreased in this case. However, if assets are not held until their tax basis is zero, deferred tax liability will increase over the holding period of future replacements. The realizable value of the replacements is decreased in this case. Thus, like-kind exchange treatment can eliminate the deferred tax advantages of holding assets for shorter periods.

Cost vs. Solvency Trade-off The analysis illustrated how like-kind exchange treatment provides a cost benefit in terms of delaying recognition of a portion of an asset's cost. In exchange for this cost benefit, a liability must be maintained. It was shown that from a long-term perspective, the cost benefit fades as the length of the overall holding period increases. However, the reduced solvency created by maintaining deferred taxes on the balance sheet does not lose its significance.

Replacement Asset Costs Analysis of the overall cost effects of like-kind exchange supported Patrick's conclusions. The discounted value of delaying deferred tax recognition was more than offset by discounted loss in future depreciation deductions in the example calculations. This research adds to Patrick's cost conclusions by addressing the solvency issues of like-kind exchange. Not only can like-kind treatment increase costs, but it can also reduce solvency by maintaining a larger deferred tax liability on the balance sheet.

Whole-Firm Analysis

The whole-firm analysis considered deferred taxes related to a firm's full complement of depreciable capital investments. Complements' fair market value, tax basis, and tax depreciation deductions were combined with complete financial statements for analysis. Specifically, the effect of asset holding periods on a firm's total deferred tax liability with and without like-kind exchange treatment was addressed. This allowed comparisons to be made between holding periods and the use and non-use of like-kind exchange treatment.

Firm Risk The whole-firm analysis without like-kind exchange treatment illustrated how a firm's risk could be materially affected by deferred taxes related to its complement of depreciable capital investments. Financial measures such as debt-to-ratio were substantially increased by consideration of deferred taxes. Analysis with like-kind exchange treatment resulted in a substantially higher deferred tax liability when compared to non like-kind exchange treatment.

Holding period analysis from a whole-firm perspective again illustrated that shorter holding periods result in lower deferred tax liabilities without significant cost increases in some cases. Thus, a firm risk exposure can be lowered without significant income loss. However, the analysis again illustrates that like-kind exchange treatment reduces the deferred tax benefits of shorter holding periods.

<u>After-tax Income</u> The analysis gave insights into income measures and deferred tax considerations. Deferred tax liability accrues asset costs to the balance sheet that taxable income and cash flow measures do not reflect. The potential of recognizing the accrued costs of deferred taxes can be important in accessing the cost of a replacement strategy. Thus, the accrued costs of deferred taxes should be considered along with income measures that do not reflect these costs.

This study illustrated how after-tax income and cash flow are increased initially by like kind exchange treatment. However, both income and cash flow will be reduced substantially in later years. In the long-term, the greatest annual cash flows will be generated by non like-kind exchange treatment.

The initially high cash-flows from like-kind treatment could be very misleading and add to a firm's risk. The 5-year like kind example in Table XVI shows after-tax income and cash flow falling by almost 50% from year 2 to year 11. If debt servicing requirements or consumption habits were established based on the year 2 figures, the firm would have to make some substantial adjustments by year 11.

Summary

Deferred tax considerations can be important to depreciable capital investment decisions. It has been illustrated that deferred tax considerations can materially influence a firm's income, cash flow, and equity (solvency). In certain situations, deferred tax liability could be reduced without significant effects on income. Given a choice between two investments with identical returns (income), but with differing levels of risk, a practical manager would generally choose the investment with a lower level of risk. This study has illustrated that in certain situations, two different investment strategies can have the almost the same cost (return), but have differing levels of deferred tax liability (risk). A practical manager would generally choose the investment strategy with the lower deferred tax liability. Decision makers should consider deferred taxes in their investment analysis.

Limitations

The focus of this research is on deferred taxes related to depreciable capital investments. Deferred tax liability can be attributable to current assets such as stored crops, and non-current assets such as appreciated land or raised breeding stock. Only deferred tax liabilities related to depreciable non-current assets are addressed in this research.

The perspectives on deferred tax liability presented in this research were developed from hypothetical situations. No specific data was collected or analyzed. The hypothetical situations (examples) were used to illustrate the considerations of deferred taxes in given situations. The examples are intended to illustrate how deferred tax analysis can be incorporated into investment analysis. Further, the examples were designed to illustrate some important trade-offs between the income and solvency issues related to deferred taxes.

The results of the research do not propose any all inclusive decision rules. They are intend to illustrate when deferred tax considerations are likely to be important. The results are intended to provide decision makers with an understanding of how deferred taxes may influence their decisions.

Recommendations

The base firm used for illustrations in this research was somewhat limited. Most financial attributes of the firm over the analysis period were held constant to allow emphasis on deferred tax changes and influences. Further research could use simulated example firms allowing more attributes to vary. This would provide further information to decision makers accessing their individual situations.

This study addresses the increased risk associated with deferred taxes and uses a financial ratio to illustrate this increased risk. A more quantifiable measure of the relative change in risk to the firm due the change in deferred tax liability would be more useful. A measure that illustrated a constraint to the firm's income or investment opportunities for instance. A more quantifiable measure of the risk associated with deferred taxes could be incorporated into future income and risk modeling.

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