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Investment strategies of farm operators typically include purchases that expand the farming operation or improve its efficiency. Investments in machinery, livestock, land and buildings are the most common. According to USDA balance sheets of the farming sector, real estate, livestock, machinery and crops make up nearly ninety percent of farm operator assets (USDA, 1989). Approximately six percent out of the remaining ten percent are held in off-farm financial assets. Based upon these statistics, it appears farmers typically diversify their holdings within farming enterprises. While the holding of financial assets is not trivial, it suggests an opportunity to expand asset diversification.

Young farmers with insufficient profits and cash flow may find the importance of and desire for farm reinvestment outweigh the benefits from off-farm investment diversification. Older farmers with established and stable operations, however, may find off-farm investments more attractive. The ability of an older farmer to make off-farm investments suggests an interest in, and the need for, pre-retirement investment planning.

Many farmers do not have a definite financial plan in preparation for retirement. Lack of knowledge about alternative investments and their potential benefits keep many farmers from investing off the farm. The issue is also complicated by regular changes in income tax laws and inflation rates.

The purpose of this discussion is twofold: (1) to identify and compare pre-retirement investment diversification strategies for farmers, and (2) to evaluate the effects of several income tax policies on optimal portfolio outcomes assuming various investor preferences. The second objective explores the hypothesis that the proportion of investments earning capital gains will be greater for a wide class of decision makers when income tax policies include favorable capital gains provisions. Our approach is to explore these relationships with the use of historical information on asset rates of return.

Procedures

Utility maximization is the goal used to analyze the outcome of farm and non-farm investment under uncertainty. A simulation model is developed to calculate the after-tax future value of investment strategies under five unique income tax environments. Generalized stochastic dominance (GSD) is used to rank investor choices and select efficient investment strategies for various levels of risk preferences.

The model is used to simulate a multi-period investment strategy with the objective to reinvest earnings and build wealth for retirement. Parameters for

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the annual contribution schedule, asset choices, portfolio weights[1] and income taxes are determined the first year and remain constant throughout the plan. The after-tax future value of an investment strategy is calculated by applying annual current and capital gains rates of return for each asset, and taxing each asset's income appropriately based upon the type of income received and participation in any tax-deferred investment plan.

The portfolio is liquidated as a lump sum at the end of the investment period (retirement). While in reality investments may be liquidated gradually through sales or annuities, the purpose of this study is not to determine the optimal disinvestment strategy. If the after-tax lump sum of a portfolio is more valuable than the after-tax lump sum of an alternative, it is likely that its annuity, gradual sale, or installment sale will also be more valuable than the alternative (Tauer).

Replications of each investment strategy determine a likely distribution of possible after-tax future values. Stochastic variables in the model are asset rates of return. They vary as randomly chosen, correlated states of nature based upon the distribution of historic rates of return for the set of assets (King). Figure 14 illustrates the flow of information through the entire simulation process.

Data

Nine alternative types of investments were chosen for analysis. These alternatives include: (1) farm assets (purchasing the set of assets that would result in an expansion of the farm), (2) farmland which would be cash rented to an operating farmer, (3) long-term U.S. government bonds, (4) high grade municipal bonds of state and local governments, (5) AA grade corporate bonds, (6) common stocks, (7) U.S. Treasury Bills with a six-month maturity, (8) six-month certificates of deposit, and (9) six-month maturity commercial paper of corporations. Although these investment alternatives vary in liquidity and maturity characteristics, they are readily available options for most farmers and provide a base for comparing the risks and returns of farm and non-farm investments.

Returns data are developed covering the 29 years from 1960 through 1988. The total rate of return is calculated as the sum of the cash or current return plus the capital gain or loss to the asset. Statistical measures for annual rates of return and variability are summarized in Table 1. Correlation coefficients are presented in Table 2. The simulation model computes annual asset returns from separate current and capital gains rates of return. Data for farm reinvestment are gathered from Southwest Minnesota Farm Business Management Association Records (Olson, et al.). Returns to cash rented farmland are calculated from historic gross rental figures for Minnesota as reported by the USDA Economic

[1] The investment portfolio of farm and non-farm assets discussed in this paper is the purchase of additional assets from annual profits and does not represent the farmer's total or existing portfolio of assets. Portfolio weights refer the proportion of the annual contribution that is invested in each asset.

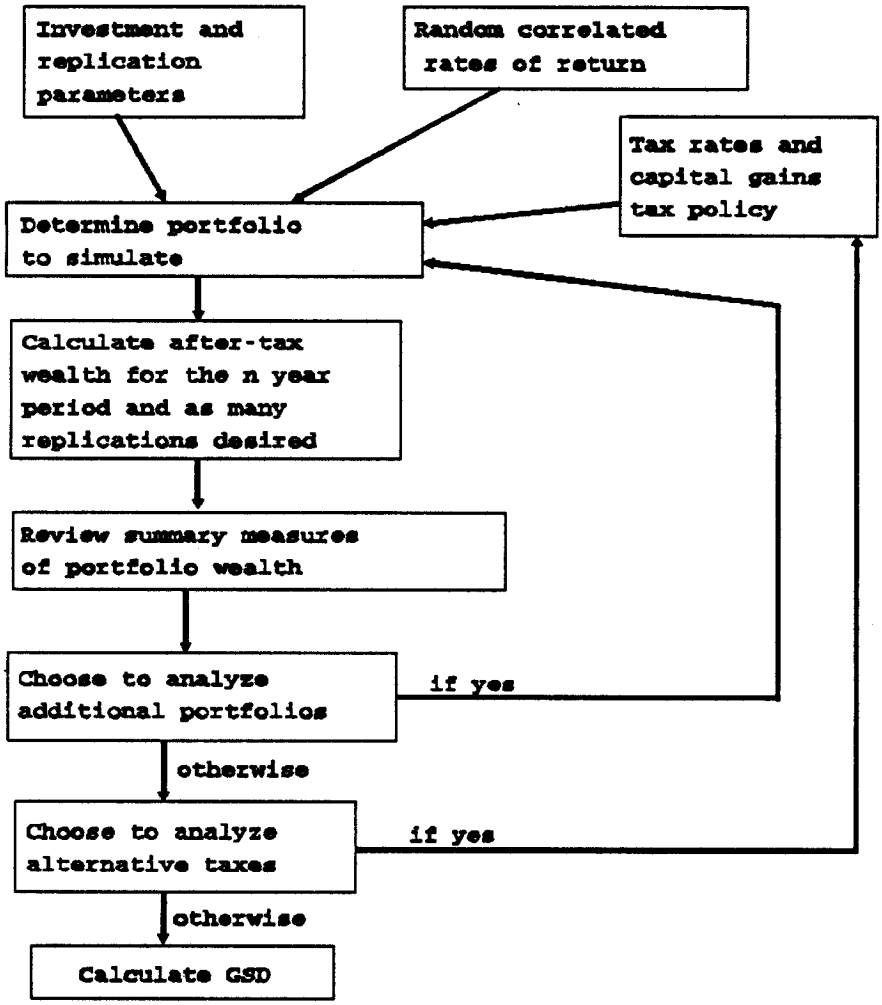

Figure 14. Flowchart of Simulation Process

Research Service. Land values and ownership charges were estimated from Schwab and Raup. Data for the remaining investment alternatives are gathered from the Federal Reserve Board of Governors and the Standard and Poor's Corporation.

Table 1. Statistical Measures of Annual Rates of Return and Risk, 1960-1988.

	Farm Assets	Farm Land	Stock Index	Gov't Bond	Muni Bond	Corp Bond	Treas Bill	Comerc'l Paper	Cert Depos	Inflation
Mean Returns					Percent					
Current	8.22	5.39	3.88	7.25	6.19	8.16	6.48	7.07	6.77	--
Capital Gain	2.45	5.20	6.53	-1.16	-0.78	-1.54	--	--	--	--
Total Return										
Minimum	-13.90	-26.79	-24.35	-4.14	-16.31	-5.26	2.59	2.97	2.50	1.01
Maximum	37.37	54.78	35.63	37.23	44.25	40.93	13.14	14.76	15.77	13.52
Median	11.17	10.88	13.79	1.58	6.01	3.98	6.03	6.39	5.50	4.20
Mean	10.67	10.59	10.41	6.09	5.41	6.62	6.48	7.07	6.77	5.00
Std Dev	10.69	16.94	14.84	9.77	13.40	10.04	2.64	2.95	3.27	3.38
CV	100	160	143	160	248	152	41	42	48	68

Table 2. Correlation Coefficients for Total Rates of Return, 1960-1988.

	Farm Assets	Farm Land	Stock Index	Gov't Bond	Muni Bond	Corp Bond	Treas Bill	Comerc'l Paper	Cert Depos
Farm Land	0.895								
Stock Index	-0.409	-0.353							
Gov't Bond	-0.558	-0.536	0.192						
Muni Bond	-0.442	-0.448	0.316	0.879					
Corp Bond	-0.506	-0.488	0.335	0.938	0.912				
T-bill	-0.015	-0.006	-0.005	0.175	-0.057	0.180			
Com Paper	0.044	0.057	-0.093	0.130	-0.125	0.110	0.987		
Cert Depos	-0.104	-0.089	0.158	0.174	-0.030	0.201	0.954	0.920	
Inflation	0.446	0.504	-0.081	-0.201	-0.338	-0.179	0.736	0.770	0.661

Simulation Parameters

Results from the simulation model are based upon a ten-year investment period. A $1,000 before-tax contribution is made to the investment strategy at the beginning of the first year. Annual contributions in years two through ten grow at an annual rate of five percent. Therefore, the before-tax contribution in year two is $1,050 and the amount in year ten is $1,551. Portfolio after-tax wealth distributions are based upon 150 replications of each investment strategy, given each income tax scenario.

Income tax rates for tax year 1989 for residents of Minnesota are used in the model. Marginal tax rates are based on farm profit levels in 1987 and 1988. Five income tax scenarios are simulated. The base scenario (Tax A) is the current income tax policy (ordinary income tax is paid on all of the realized capital gain). Two proposals for capital gains tax reform (Tax B and Tax D) are analyzed in addition to the policy before the Tax Reform Act of 1986 (Tax C). An investment strategy is also simulated under the scenario that an investor's marginal income tax rate declines after retirement (Tax E). Table 3 contains these five tax policy scenarios.

The effects of diversification are evaluated by comparing 39 pre-determined investment strategies. Table 4 provides a listing of these strategies and the percentages of assets contained in each strategy. In an effort to simulate optimal portfolios, strategies were developed from earlier studies that used

Table 3. Tax Policy Scenarios

Tax Policy Scenario	Type	Tax Nominal or Real Capital Gain	Capital Gains Exclusion	Marginal Tax Rates Before Retire Federal	Before Retire State	After Retire Federal	After Retire State
			Percent				
Tax A	Current	Nominal	0	28	8	28	8
Tax B	Proposed	Nominal	30	28	8	28	8
Tax C	Pre-1986	Nominal	60	28	8	28	8
Tax D	Proposed	Real	0	28	8	28	8
Tax E	Low Retire Rate	Nominal	0	28	8	15	8

Table 4. Portfolio Configurations of Investment Strategies

Investment Strategy[a]	Investment Alternatives: Whole Farm	Farm Land	Stock Index	Govt Bond	Muni Bond	Corp Bond	T-bill	Com'cl Paper	CD
	Percent of Portfolio[b]								
Farm	100								
Land		100							
† Stck			100						
Govt				100					
Muni					100				
Corp						100			
TBil							100		
Papr								100	
CD									100
StkY			100*						
GovY				100*					
CorY						100*			
TBiY							100*		
CD-Y									100*
† FS-1	75		25*						
† FS-2	50		50*						
FS-3	33		67*						
FS-4	25		75*						
FS-5	15		85*						
LS		50	50*						
‡ FCd1	70								30*
‡ FCd2	25								75*
SCd			70*						30*
FM	70				30				
SGC			50*	25*					25
SMC			20*		20				60*
SGT			33*	33*			34*		
FGCd	33			33					34*
FST1	30		30*				40*		
FST2	40		30*				30*		
FST3	40		40*				20*		
FSC1	15		15*						70*
† FSC2	25		20*						55*
† FSC3	50		15*						35*
† FSMC	60		15*		10				15*
FSGC	40		10*	20*					30*
FSMt	10		10*		10				70*
† FSMd	20		10*		10				60*
5-1	20		20*	20*		15*			25*

[a]A dagger preceding the name indicates the strategy is developed from an optimal portfolio in Young and Barry. A double dagger indicates the strategy is developed from an optimal portfolio in Crisostomo and Featherstone.

[b]Unless otherwise specified, investments are taxed normally. An asterisk indicates an asset is invested in a tax-deferred retirement savings plan, such as IRA or Keogh account.

quadratic programming to identify optimal diversification (Young and Barry; Crisostomo and Featherstone). The first fourteen strategies define single-asset portfolios, five of which are tax-deferred retirement savings plans. The remaining 25 strategies are portfolios comprised of two to five assets, most including a moderate amount of farm reinvestment.

Attitudes toward risk and return are separated into eight unique utility groups to determine different types of investor behavior. Generalized stochastic dominance is calculated over each interval to determine the efficient set of investment strategies. Table 5 is a list of the absolute risk aversion coefficients used in the empirical analysis. Utility group 1 is the most risk-preferring group. The interval on absolute risk aversion is −.002 to −.001. Utility group 3 represents risk neutral investors. Risk averse investors are classified in utility groups 4 through 8. Empirical evidence suggests the majority of farm investors are in utility groups 3 through 6 (Wilson and Eidman).

Table 5. Risk Aversion Coefficients for GSD

Utility Group	Description	Constant Absolute Risk Aversion Coefficients: Lower Bound	Upper Bound
1	Highly risk preferring	-.0020	-.0010
2	Moderately risk preferring	-.0010	-.0001
3	Risk neutral	-.0001	.0001
4	Slightly risk averse	.0001	.0003
5	Somewhat risk averse	.0003	.0006
6	Moderately risk averse	.0006	.0012
7	Highly risk averse	.0012	.0020
8	Extremely risk averse	.0020	.0030

Efficient Portfolios

Figure 15 illustrates the relationship between the portfolio after-tax mean future values and the standard deviations of future values under the base income effects of diversification. Greater after-tax mean future values may be achieved from diversified portfolios such as **FST3**, **LS**, **FS-2** and **FSC2** with nearly the same (or less) risk compared to the portfolios that are exclusively individual assets. Similar efficient frontiers result from the simulations for the other four income tax scenarios.

Results from generalized stochastic dominance are presented in Table 6. The set of efficient investment strategies is identified for each utility group. First consider the base tax scenario (Tax A). The after-tax, value-maximizing strategy is the single asset strategy **StkY**. This is the dominant strategy for utility groups 1 through 3. As soon as investors become slightly risk averse, multi-asset portfolios enter the efficient set, and more than one strategy may be efficient. Two-asset portfolios dominate the efficient set for utility groups 4 and 5. Investors with greater risk aversion (groups 6 through 8) choose portfolios with three assets. As risk aversion increases, greater weight is

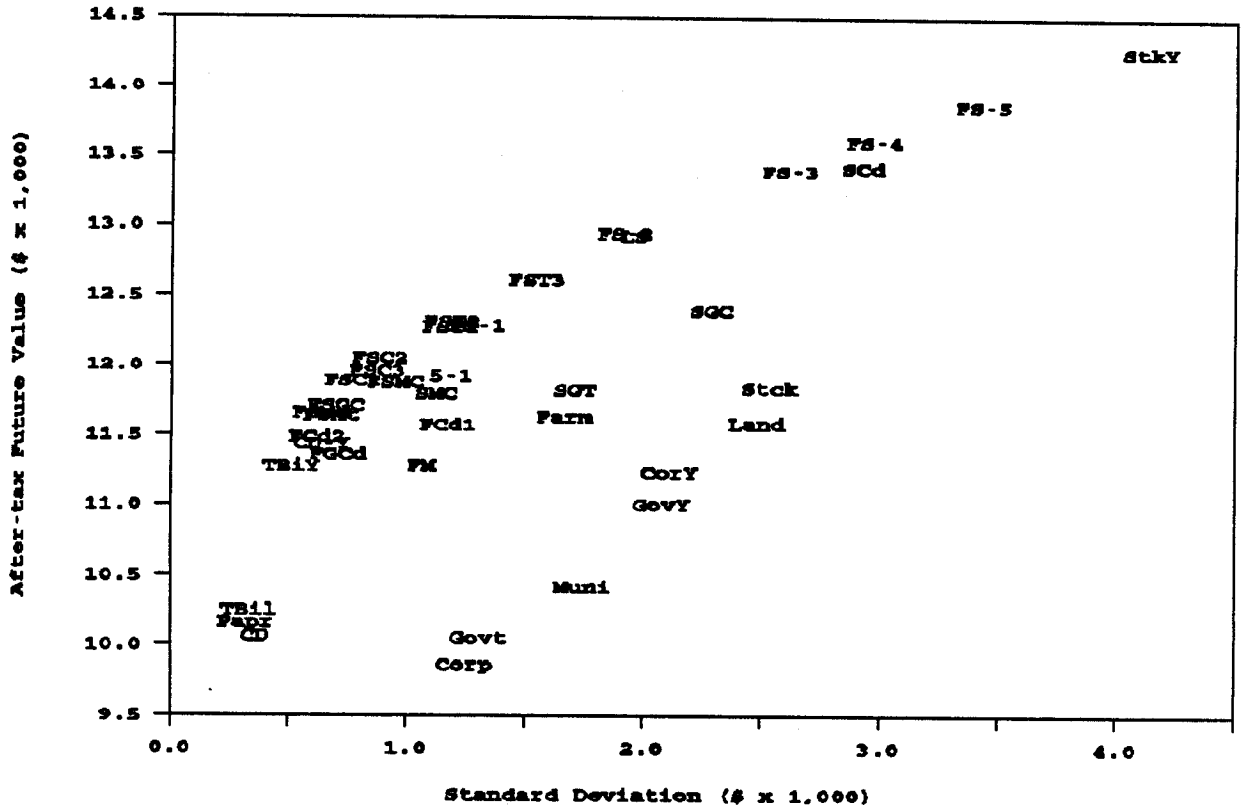

Figure 15. After-tax Mean Future Value and Standard deviation in Tax Scenario A

placed upon T-bills and CDs.

Figure 3 illustrates the efficient investment strategies for the base tax Figure scenario (Tax A). Slightly-to-moderately risk-averse investors combine farm assets and stock market IRAs in their efficient portfolio. The amount of farm assets increases from 15 to 50 percent with increased risk aversion, and then declines at higher levels of risk aversion. Moderately-to-highly risk-averse investors add T-bills or CDs to efficient portfolios and decrease their holdings of both farm and stock market assets. Purchasing farmland to rent to an operating farmer is not an efficient activity in this simulation. Farmland is only purchased in proportional expansions of the existing farm enterprise as suggested by the farm reinvestment strategy.

Alternative Tax Scenarios

Table 6 also describes the efficient portfolios for alternative income tax scenarios. Figures 16 through 19 illustrate differences in investment strategies due to changes in the simulated income tax scenarios. The results indicate that investor behavior may significantly depend on the scope or nature of tax reform.

Investor preferences are identical over all utility groups when scenarios Tax A and Tax B are compared. Excluding taxes from 30 percent of nominal realized capital gains tends to increase after-tax portfolio wealth, but does not affect

Table 6. Efficient Stochastic Dominance Sets for Alternative Tax Policies

Tax Scenario	Utility Group 1	2	3	4	5	6	7	8
Tax A: tax 100 percent of capital gain, current tax policy	StkY[a]	StkY	StkY	Stky[b] FS-3 FS-4 FS-5	FS-2 FS-3	FS-2 FST2 FST3 FSC2	FSC2	FSC2
Tax B: exclude 30 percent of capital gain, proposed tax reform	StkY	StkY	StkY	Stky FS-3 FS-4 FS-5	FS-2 FS-3	FS-2 FST2 FST3 FSC2	FSC2	FSC2
Tax C: exclude 60 percent of capital gain, pre-1986 tax policy	StkY	StkY	StkY	StkY FS-3 FS-4 FS-5 LS	FS-2 LS	FS-2 FST2 FST3	FST2 FSC2	FSC2
Tax D: tax real capital gains at full rate, proposed tax reform	StkY	StkY	StkY	StkY FS-2 FS-3 FS-4 FS-5	FS-1 FS-2	FS-1	FS-1 FSC3 FSMC	FSC3
Tax E: retirement tax rates decline, reduced retirement income	StkY	StkY	StkY	StkY FS-5 SCd	SCd FSC1	FSC1	FSC1	FSC1 CD-Y

[a]Indicates investor in Utility Group 1 prefers StkY investment strategy to all other strategies.

[b]Indicates investor in Utility Group 4 is indifferent between four investment strategies, and that these four strategies are preferred to all other strategies.

investor behavior. However, income tax scenarios C, D and E elicit noticeable changes in investor behavior. If the capital gains tax exclusion is increased from 30 to 60 percent (Tax C), cash-rented farmland is added to the efficient set in utility groups 4 and 5 (Figure 17). Risk-averse investors also hold greater amounts of farm and stock assets with a 60 percent capital gains tax exclusion than under the base scenario. This suggests favorable capital gains tax treatment encourages additional investments in capital assets. Specifically, these are assets that exhibit a larger proportion of their total return as capital gains, but also those that have higher variability in total rates of return.

Investor behavior changes more dramatically when capital gains taxes are based upon the real capital gain instead of the nominal capital gain, as in scenario Tax D.[2] Greater amounts are reinvested in the farm (50 to 75 percent of the portfolio) throughout utility groups 4 through 8 (Figure 18). This is noticeably more than under the base income tax policy (Figure 16). Only three efficient portfolios include T-bills, CDs or bonds, and their combined total never exceeds 35 percent in this tax scenario. Real capital gains taxation encourages highly risk-averse investors to reinvest more in the farm operation and less in off-farm assets.

[2] These results were simulated with a five percent inflation rate. If a lower inflation rate were simulated using the same nominal rates of return, the tax liability would increase due to larger real capital gains. Fewer changes in investor behavior would be expected relative to those observed under the five percent inflation rate.

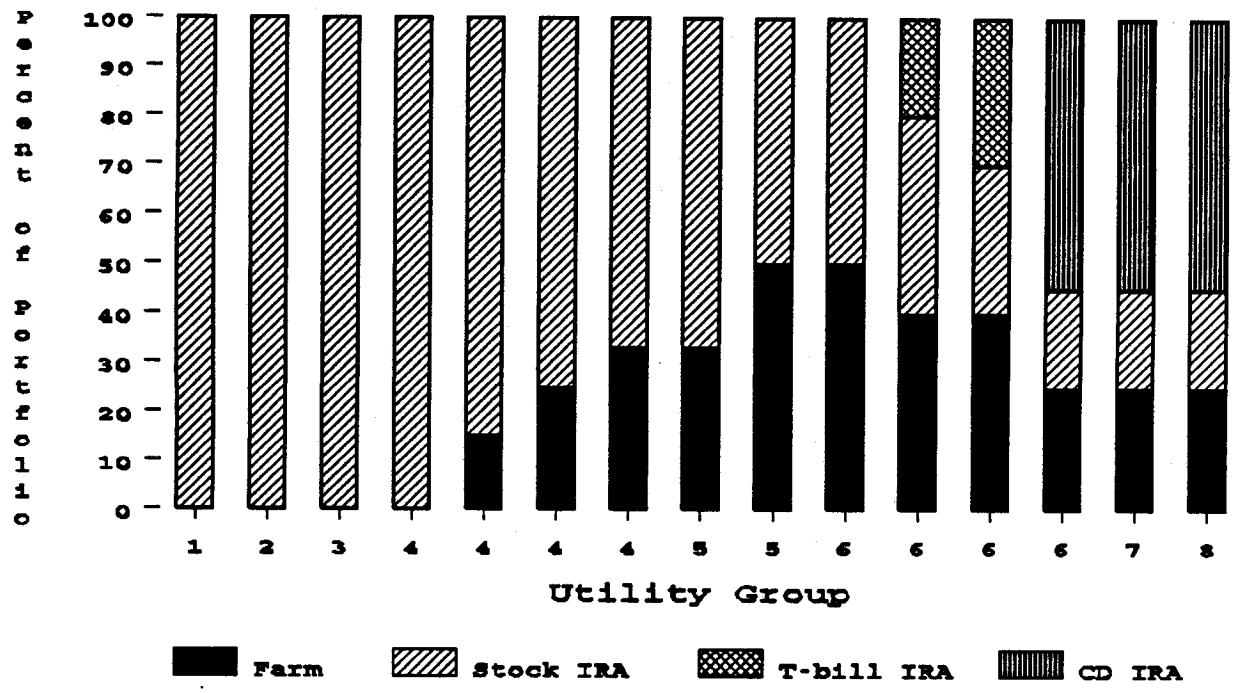

Figure 16. Efficient Portfolios for Tax Scenario A (current tax policy) and Tax Scenario B (exclude 30 percent of capital gain)

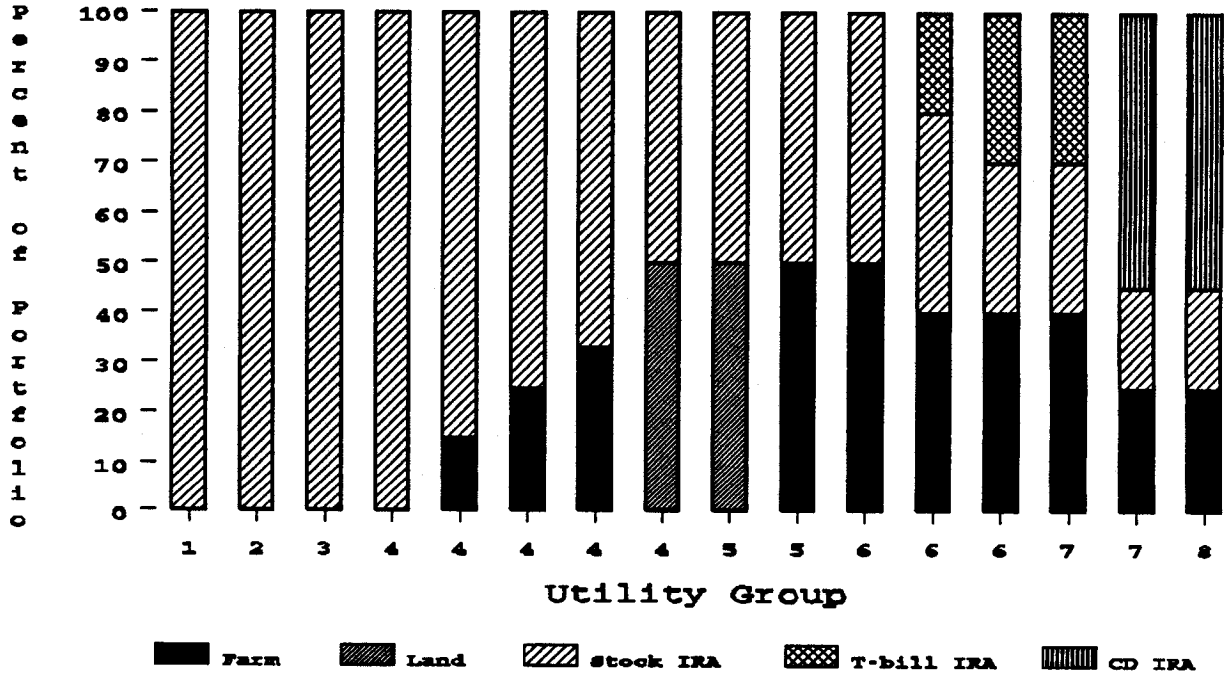

Figure 17. Efficient Portfolios for Tax Scenario C (exclude 60 percent of capital gain)

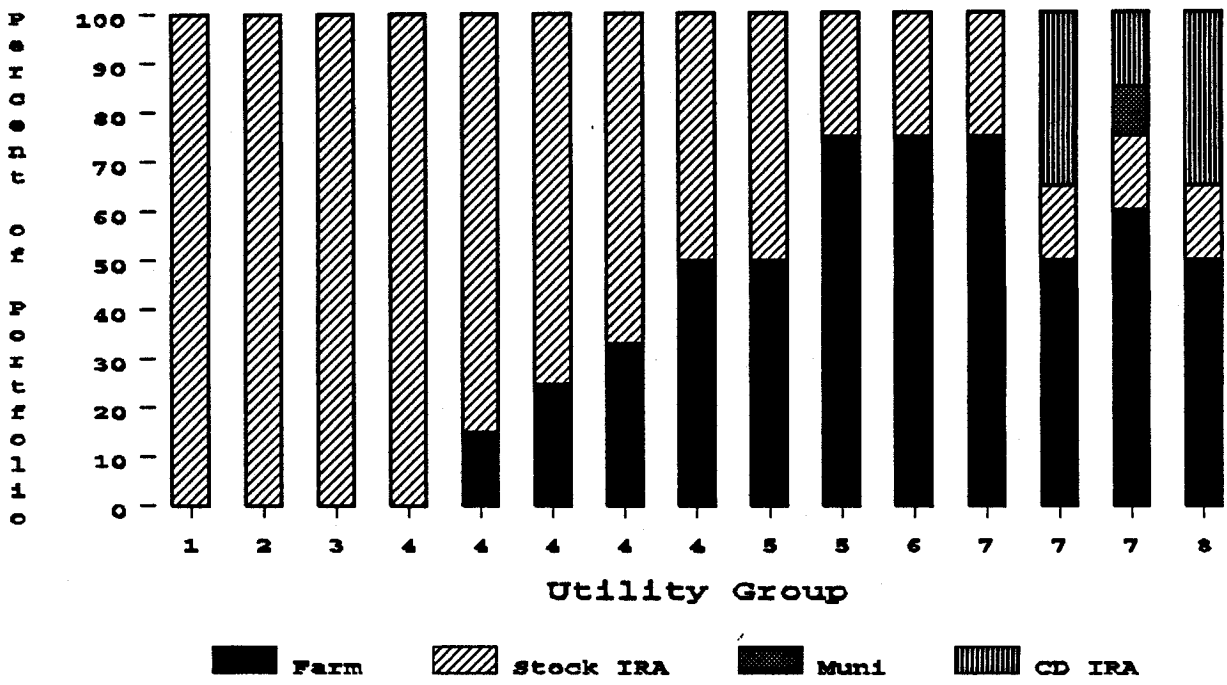

Figure 18. Efficient Portfolios for Tax Scenario D (tax real capital gain)

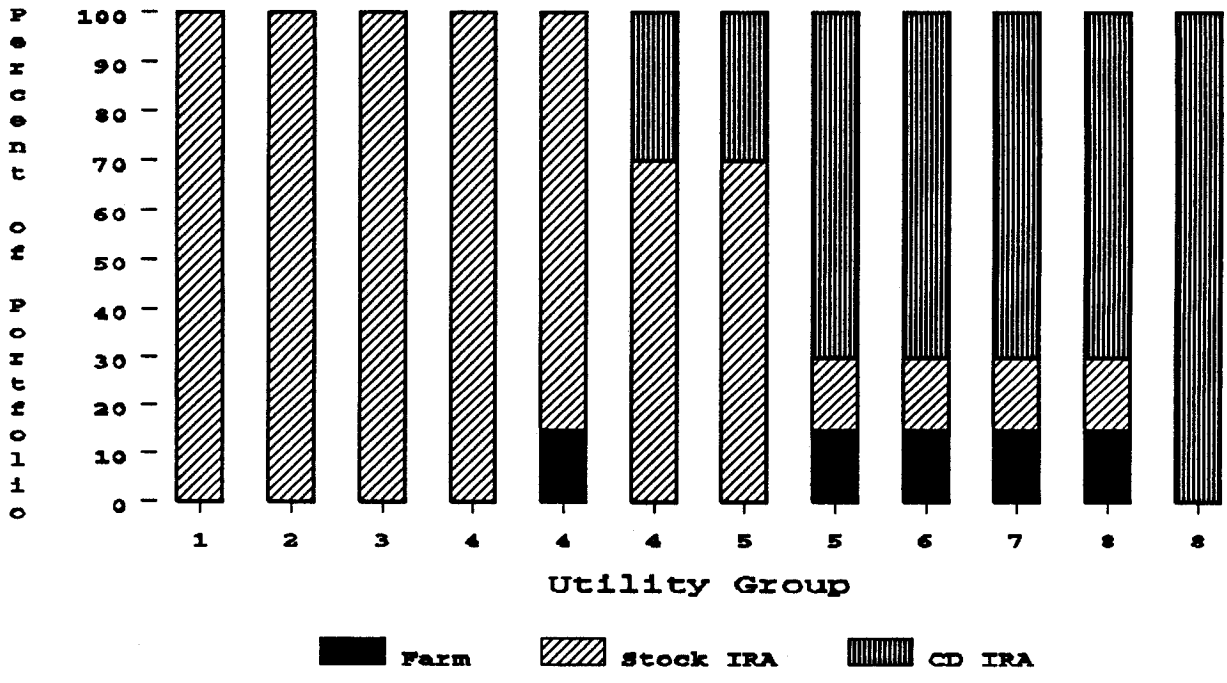

Figure 19. Efficient Portfolios for Tax Scenario E (tax rate declines in retirement)

If an investor believes his marginal tax rate will decline in retirement, as in scenario Tax E, the efficient set of portfolios shifts to enhance tax-deferred retirement savings plans (Figure 19). Portfolios are selected that place greater proportions of the assets in IRA and Keogh accounts. Figure 19 indicates farm assets never exceed 15 percent of an efficient portfolio in this scenario. Between 85 and 100 percent of retirement funds is invested in stock market IRAs and/or CD IRAs.

Conclusion

Empirical evidence based on simulations and returns data covering the 1960-1988 period supports the claim that diversification reduces risk. Stochastic dominance analysis suggests nearly all risk-averse investors prefer a diversified portfolio to any single real or financial asset. Investors willing to accept moderate amounts of risk weight their portfolio more heavily with stocks[3] and farm assets. Highly risk-averse investors hold greater proportions of T-bills and CDs. Dominant portfolios rarely include more than two or three assets. This suggests the greatest benefits from diversification are achieved with a small number of assets.[4] This result underscores the importance of having reliable estimates of correlation relationships between asset rates of return.

Income tax reforms may have significant effects on investor behavior depending upon the scope and nature of the reform. Results from the simulation model indicate the primary response to increasing the tax shelter for capital gains is to increase the proportion of assets that will generate capital gains. However, two proposed capital gains tax reforms imply very different investor responses. The proposed tax policy that excludes 30 percent of nominal capital gains from taxation causes no deviation in our set of simulated efficient portfolios. This result contrasts with moderate changes in efficient portfolios under the tax policy before the Tax Reform Act of 1986. The proposed policy which taxes only real capital gains causes investors in our simulation model to invest a significantly greater proportion of their portfolio in capital assets. If future inflation rates decline relative to historic capital appreciation rates, the difference between the proposed real and nominal capital gains tax policies would be less significant than indicated.

Simulation results also demonstrate the significance of the income tax deferral offered by IRA and Keogh retirement savings plans. If an investor's marginal tax rates are expected to decline in retirement relative to taxes paid prior to retirement, IRA and Keogh accounts are highly preferred over reinvestment in the farm operation.

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[3] This is a broad index of stocks and as such has some built in diversification as one might find in a mutual fund.

[4] Note that investments within each of the simulated assets are implicitly diversified by the average rate of return.

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