Risk-Adjusted Farm Income Enhancement by Holding Off-Farm Investments

Eustacius N. Betubiza and David J. Leatham

Proceedings of
Regional Research Committee NC-161

FINANCING AGRICULTURE IN A CHANGING ENVIRONMENT: MACRO, MARKET, POLICY AND MANAGEMENT ISSUES

Kansas City, Missouri
September 24-25
1990

Department of Agricultural Economics and Rural Sociology
The Pennsylvania State University
University Park, Pennsylvania 16802
May 1991

RISK-ADJUSTED FARM INCOME ENHANCEMENT BY HOLDING OFF-FARM INVESTMENTS

Eustacius N. Betubiza*
and
David J. Leatham

Abstract

A Discrete Stochastic Programming model is formulated to study the gains from diversification when farming operations are augmented with off-farm financial assets that are not highly correlated with returns from farming. We extend past research by considering the dynamics of accumulating these financial assets and, consequently, the liquidity implications involved. We further consider the liquidity characteristics and tax effects of these financial assets, and the farm's leverage and tenure position. Results show that farmers would be better off, as reflected by higher certainty equivalents of ending wealth, if mutual funds are added to their farm portfolios.

INTRODUCTION

The 1980s were difficult for the American farm sector, including agricultural lenders. For example, whereas only 4.6% of the direct loans made by the Farmer's Home Administration were delinquent in 1980, the figure stood at 34.5% by 1988 (United States Department of Agriculture). In 1982, 2.5% of the farm production loans made by commercial banks was reported as non-performing, but this figure had jumped to 4.0% by 1988 (Board of Governors of the Federal Reserve System). Volatile and high interest rates, and weak agricultural commodity prices have forced many farmers and farm lenders out of business. This has further fueled the need to develop longer-term perspectives on how to manage risk by all concerned: farmers, farm investors, and agricultural lenders. Several studies have concentrated on nonfarm equity holdings in agriculture (Fiske et al., Collins and Bourn, Matthews and Harrington, and Raup). Less work has been done in the area of holding nonfarm financial securities like stocks and bonds in a farm portfolio in order to bring more stability to farm enterprises. Renna P. Young and Peter J. Barry examined the possible gains in risk efficiency as greater proportions of financial assets were introduced into the asset structure of farm portfolios. However, they did not consider the dynamics of the process of accumulating these financial assets and, consequently, the liquidity implications involved, nor did they consider the direct liquidity characteristics of these financial assets, tax effects, and the farm's tenure position. In this study we explicitly incorporate these features as we investigate the effect of holding mutual fund shares and Certificates of Deposit (CDs) in a farm portfolio on the farmer's expected returns and overall risk exposure.

The rest of the paper is organized as follows: first, we present the conceptual framework; second, we describe the model itself; and finally, we present the results and conclusions.

---

* The authors are Graduate Research Assistant and Associate Professor, Department of Agricultural Economics, Texas A&M University, College Station, Texas.

CONCEPTUAL FRAMEWORK

The uncertainty a farmer must manage includes uncertainty yields, product prices received, input prices paid, and interest paid on debt. By judiciously selecting a set of farm and off-farm investments to include in his portfolio, a farmer can reduce the variability of these cash flows to the level commensurate with his risk-return preferences.

Consider the following equation:

$$\sigma_p^2 = \sum_{i=1}^{N} W_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{j=1}^{N} W_i W_j r_{ij} \sigma_i \sigma_j \text{ for } i \neq j,$$

where σ_p^2 is the variance of the portfolio, W_i is the weight of the ith asset in the portfolio -- with the weights determined by the proportion of value in the portfolio, σ_i^2 is the variance of the returns to the ith asset, σ_i is the standard deviation of the returns to the ith asset and σ_j the standard deviation of the returns to the jth asset, and r_{ij} is the correlation coefficient between the returns of assets i and j. The term $r_{ij}\sigma_i\sigma_j$ is the covariance between the returns of assets i and j. The value of r_{ij} falls between +1.0 and -1.0, and the smaller it is, the smaller the variance of the portfolio. When off-farm investments that are not highly correlated with returns to farming are included in a farmer's portfolio, they can help reduce the overall risk of a farming operation, with risk being measured in terms of variance. As will be discussed later in the paper, such an investment strategy can enhance the liquidity of the entire portfolio and reduce risk per unit of expected wealth.

Investment Opportunities

In this study, a farmer can invest in land, stocks, and CDs along with farming. He can purchase land which he can either operate or rent to someone else. When a farmer operates his own land, he not only gets to keep the total return to the farming operation, but also any accrued capital gains (or capital losses). Moreover, land can be used as collateral against debt. Also, a farmer may choose to rent land instead of owning it, although there are uncertainties of whether land will be available to rent at the time when it is needed, and within a preferred location. Long term leases can be used to mitigate some of the risk.

Another investment opportunity is stock. Because of the diversified composition of mutual funds, they offer a return that is relatively less risky than individual stocks. Nine mutual funds were initially picked based on the availability of historical data, and the composition of their portfolio. Those picked had a large proportion of their funds invested in utilities, pharmaceuticals, chemicals, and office equipment, i.e. things that were thought not to be highly correlated with agriculture. A simple pair wise correlation coefficient was computed for historical returns to farm assets and equity, and each of the returns to the mutual fund. The Massachusetts Investors Trust fund was picked because its returns were the least correlated with the returns to agriculture.[1] This low relationship enhances income stability and liquidity of the overall farm portfolio because high stock returns may compensate for losses in poor farm income years, which will stabilize the overall cashflows of the farm.

The farmer can also invest in Certificates of Deposit (CDs). Short term CDs are fairly liquid and their liquidity feature can be enhanced when purchased in staggered sets, so that every month a set of CDs is maturing. Another important feature of CDs is that they have almost zero risk since their principal and coupon payments are guaranteed. However, a short term CD has higher reinvestment risk since the frequent reinvestment of the principal and interest received has to be done at the prevailing (and probably different) rate.

We conducted a study in which a tenant farmer had the options of investing in land, mutual funds, and CDs. A Discrete Stochastic Programming (DSP) framework was used because it allows for jointly modeling the uncertainties that are associated with the objective function, the technical coefficients, and the right hand sides. DSP was developed by Cocks in 1968 and has been applied in agricultural economic studies (Apland and Kaiser; McCarl, Reid, and Tew). However, its use in investment and financing decisions has been limited. The most recent applications include Featherstone and Baker, and Leatham and Baker.

Liquidity is important to the farmer so that short falls in revenue can be covered during unprofitable years. In order to account for liquidity aspects in the model, sources and uses of funds for each state of nature were included, along with disinvestment activities for assets in which sale prices depend on the state of nature.

The leverage effect on the overall financing and investment decision was captured by having stochastic product prices, yields and the cost of debt, return to assets, family withdrawals and taxes. The tax system used in the model follows the 1988 Tax Rate Schedules of the Internal Revenue Service, specifically Schedule Y-1.

MODEL SPECIFICATION

The model is based on a representative farm in the Texas Rolling Plains. It is assumed that a farmer can operate his own land, in which case he pays all the costs of production, but also takes all the revenue. Alternatively, he can share-lease the land operated, in which case the costs of production and the revenue are shared according to the terms of the lease. The share lease arrangement used in this study is based on the budgets for the Rolling Plains area of North Texas which are prepared by the Texas Agricultural Extension Service.

---

[1] In order to test whether this low relationship between farm returns and mutual fund returns that had been observed in the historical data was maintained during the modeling process, another pairwise correlation was done using farm returns and mutual fund returns generated from this model. The results showed that this relationship was maintained in the model.

rates to targeting monetary aggregates. The real return on the mutual fund had a trend term and lagged real mutual fund prices as the regressors. Cotton yield and cotton prices were assumed to follow a random walk process. Expected wheat yield was estimated as a function of lagged wheat yields and a trend term, whereas real wheat price was estimated as a function of both lagged wheat price and lagged wheat yield. The regressors for real land price were lagged real land price and inflation rate. The regressors for the mutual fund price were its lagged values.

Second, a variance-covariance matrix of the residuals from these equations was computed and was used in a Monte Carlo simulation, along with the means of the residuals, to generate fifty random observations. These were then added to each of the ten forecast equations at the beginning of every year to generate the distribution of expected values for each variable.

The fifty values for crop prices, crop yields, and interest rates were used to generate stochastic returns to farming based on crop budgets prepared by the Texas Agricultural Extension Service. Two sets of returns to farming were generated: returns to a lessee (a farmer who operates leased land) and returns to a landowner. It is important to note that if a farmer operates his own land, then the two components of returns accrue to him. Historically, the two predominant crops grown in the Rolling Plains region of north Texas are wheat and cotton. It was assumed that the farmer would grow these crops in equal proportions. The following paragraphs describe how returns to farming for a lessee were calculated, although the same procedure holds true for a landowner as well.

The above equation says that the return to total assets is equal to the return to farming operations, plus the return to off-farm investments, all weighted by their respective proportions in the overall farmer's portfolio. The average interest rate paid on debt was specified as follows:

$$i = TBILL + 0.02,$$

where TBILL = the yield on a three-month Treasury Bill. The interest rate paid on farm debt was assumed to be 2 percentage points above the Treasury Bill rate. This reflects the historical spread between farm loans and the three month Treasury Bill rate. It was assumed that lenders will only provide loans up to two times the level of equity of the farm operator.

It is important to note that returns to farming operations are in turn functions of the price and yield of wheat, the price and yield of cotton, and the interest rate paid on operating capital. Because of this association between the stochastic variables and farm growth, the farm growth variable was used to rank the variables from the highest to the lowest growth.

The reorganized matrix was split into equal blocks where each block represented a state of nature for a given stage and the median value of each block was picked as the representative value for that state of nature.

Investment Scenarios

Seven investment scenarios were simulated (Table 3). In all the scenarios, the farmer operates 500 acres of land which is a representative size of farming operations in the Texas Rolling Plains. However, the farmer does not necessarily own all the 500 acres, as described below. The farmer starts off with an initial equity of 75,000 dollars, and holds cash in form of CDs.

In the first scenario, the farmer owns 250 acres of the 500 acres operated. The remaining 250 acres is operated under a share lease arrangement. In this scenario, the farmer does not have the opportunity to invest in mutual funds. The second scenario differs from the first only by giving the farmer the opportunity to invest in additional land. Thus, in addition to the 250 acres already held, the farmer can purchase more land. In the third scenario, the farmer does not have the option of investing in additional land, but can invest in mutual funds. The fourth scenario, however, gives the farmer both the options of investing in additional land and mutual funds. The fifth scenario simulates a farmer with an even less initial land investment. He holds 20 acres of land, but has the option to invest in mutual funds. The sixth does allow for further purchases of land in addition to the mutual fund option. The seventh scenario does not have the mutual fund option. Each of the seven investment scenarios was run under eleven different risk aversion levels and the corresponding certainty equivalents of ending wealth compared.

RESULTS

Table 4 shows certainty equivalents for the seven alternative investment scenarios computed at eleven different risk aversion levels. In the first scenario, a "highly" risk averse farmer (e.g. Pratt risk aversion parameter = 0.0001) has a certainty equivalent of ending wealth of 72.15 thousand dollars, compared to 123.22 thousand dollars for a less risk averse farmer (e.g. Pratt risk aversion parameter = 0.000009). When the opportunity to invest in more than 250 acres is available (second scenario), there is a marginal increase in certainty equivalents of ending wealth (a change of 1.69 thousand dollars for the highly risk averse case, and 3.9 thousand dollars for the least risk averse case). As expected, the increase for the least risk averse case is more than the increase experienced by the highly risk averse case. The latter invested in more additional land that the former. However, when the option to invest in mutual funds replaced the option to invest in additional land (third scenario), the highly risk averse case obtained a certainty equivalent of ending wealth of 119.62 thousand dollars, an increase of 47.52 thousand dollars over the corresponding figure in the first scenario. The least risk averse case experienced an increase of 42.39 thousand dollars over the corresponding figure in the first scenario, but had 45.94 thousand dollars more when compared to the third-scenario highly risk averse case. The option to invest in mutual funds enhances the stability of the overall returns to the farmer's operations. The increases in the fourth scenario over the levels in the third scenario was very modest (0.22 thousand dollars for the highly averse case and 2.49 thousand dollars for the least averse case) indicating how the option to invest in more land had relatively less improvement on overall farm revenue when compared to the mutual fund option.

In the fifth scenario, the farmer was assumed to hold 20 acres of land (just around his homestead). This meant that he had less of his equity tied up in land and, consequently, more of his equity freed up for investment in mutual funds. There was a 9.1 thousand dollar increase in certainty equivalent of ending wealth over the previous scenario for the highly averse case, and a corresponding 4.96 thousand dollar increase for the least averse case. Perhaps the most interesting scenario was the sixth , where both options (land and mutual fund investments) were available to the farmer, with an initial land investment of only 20 acres. As expected, since the farmer had the most flexibility, this scenario showed the highest gains, with the highly risk averse farmer getting a certainty equivalent of 130.41 thousand dollars, and the least averse farmer making 177.34 thousand dollars in certainty equivalent. The farmer had the most flexibility. An additional scenario without a mutual fund option was also run, but, as expected, only performed better than scenarios 1 and 2. Thus a farmer who is less locked up in land investments is better able to take full advantage of diversification into off-farm investments.

Figure 1 shows coefficients of variation of ending wealth plotted against risk aversion parameters for three investment alternatives: 1) investment in at least 250 acres, with no mutual fund option; 2) investment in at least 250 acres with a mutual fund option; and 3) investment in at least 20 acres with a mutual fund option. The coefficient of variation is an indicator of the amount of risk (as measured by standard deviation) relative to the amount of the expected value. As can be seen from the figure, the investment alternative with the least initial land commitment and a mutual fund option had the lowest risk for every dollar of expected ending wealth, whereas the investment alternative without a mutual fund option had the highest risk per dollar of expected ending wealth for all risk aversion levels.

Figure 2 shows cumulative probability distributions for ending wealth solved at one level of risk aversion for the following two investment alternatives: 1) the farmer holds at least 250 acres of land without a mutual fund option; and 2) the farmer holds at least 250 acres of land with a mutual fund option. It is clear from the graphs that the second investment alternative dominates the first by first-degree stochastic dominance.

Next, the average portfolio composition was calculated over the investment horizon. Tables 5, 6, and 7 report the results of three investment alternatives solved at a medium risk aversion level. For the scenario where the farmer had the opportunity to invest in land (in addition to 250 acres already owned) but not in mutual funds, at least 97% of the farmer's investment was in land in any given year (Table 5). However, when both the land and mutual fund options were available to the farmer, land investment ranged from a low of 42.08% to a high of 72.09% of the total investment (Table 6). In four out of the five years in the farmer's investment horizon, less than 50.00% of his total investment was in land. When only 20 acres of land were initially held, with both land and mutual fund investment options available, land investment as a percentage of total investment ranged from 5.79% to 33.66%, whereas mutual fund investment ranged from 66.11% to 94.21% (Table 7). Although these statistics vary for different risk aversion levels, the trend is the same. Expected Utility maximizing farmers will tend to prefer a portfolio which includes mutual funds that are less correlated with returns from their farming operations, to an investment in land only.

Summary and Conclusions

A Discrete Stochastic Programming model was formulated to study the gains from diversification when farming is augmented with land investment, off-farm investments like mutual funds, and CDs, using farming data from the Rolling Plains area of north Texas. This framework made it possible to model uncertainties in the objective function, the technical coefficients, and the right hand sides. Furthermore, it made it possible to model a multi-year planning horizon. The result of the analysis showed that farmers obtained higher certainty equivalents when their farm portfolios included mutual funds than when these off-farm investments were excluded. The farmers that were the least averse to risk experienced the highest gains.

This study has shown that off-farm investments can help reduce variability in overall net income. Further research should be done in identifying groups of off-farm investments whose returns are less correlated with returns to agriculture. For example, oil stocks or funds that are heavily invested in oil stocks could help stabilize farmers' portfolio performance since high oil prices hurt agriculture but boost oil stocks. Food company stocks also need to be investigated. Low wheat and corn prices, for example, result in decreased revenues to the farmer, but these same low prices imply cheap inputs to the breakfast cold cereal manufacturers. Losses incurred on farm produce sales can be partially offset by gains on share prices of these stocks or in share value of funds heavily invested in these stocks. Whereas a lot of work has been done in the area of risk mitigation through options and futures, little work has been done in the use of off-farm investments and the advantages this approach could have over the traditional methods. Identifying these sets of stocks, for example, can be useful to part-time farmers who are less heavily invested in agriculture and, thus, could use their surplus capital to invest in non-farm investments. But these non-farm investments have to be the 'right' ones considering that these people are also invested in agriculture. Land owning farmers can sell off part of their land holdings and invest the proceeds in off-farm investments whose returns are not highly correlated with returns to farming. Some farmers might be better off entering into long term lease arrangements, which would cost less than purchasing land, and invest the rest of their equity in off-farm investments.

REFERENCE

Apland, J. D., and H. Kaiser. "Discrete Stochastic Programming: A Primer, pp. 84-88: University of Minnesota Staff Paper Series, March 1984.

Board of Governors of the Federal Reserve System. Agricultural Finance Databook. Division of Research and Statistics. Washington, D.C. April 1988.

Collins, Robert A., and H. Joseph Bourn. "Market Requirements and Pricing for External Equity Shares in Farm Business." American Journal of Agricultural Economics 68(1986):1330-1336.

Cocks, K.D. "Discrete Stochastic Programming." Management Science 15(1968):72-79.

Department of Treasury, Internal Revenue Service. Informational Copies of Federal Tax Forms 1988. Package X, Volume 1.

Featherstone, Allen, and Timothy G. Baker. "Farm Portfolio Adjustments to the Elimination of U.S. Target and Support Price Provisions". Financing Agriculture in a Changing Environment: Macro, Market, Policy and Management Issues. Proceedings of Regional Research Committee NC-161. St. Paul, Minnesota, October 7-8,1986.

Fiske, John R., Marvin T. Batte, and Warren F. Lee. "Non-farm Equity in Agriculture: Past, Present, and Future." American Journal of Agricultural Economics 68(1986):1319-1323.

Leatham, David J., and Timothy G. Baker. "Farmers' Choice of Fixed and Adjustable Interest Rate Loans". American Journal of Agricultural Economics 70(1988):803-812.

Matthews, Stephen F., and David H. Harrington. "Analysis of Non-farm Equity forms of Investment Applicable to Agriculture." American Journal of Agricultural Economics 68(1986):1324-1329.

McCarl, Bruce A. and David A. Bessler. "Estimating an Upper Bound on the Pratt Risk Aversion Coefficient when the Utility Function is Unknown". Australian Journal of Agricultural Economics 33(1989):56-63.

McCarl, Bruce A., Donald W. Reid, and Bernard V. Tew. "Innovations in Programming Techniques for Risk Analysis". Paper presented at S. Reg. Proj. S-180 seminar, An Economic Analysis of Risk Management Strategies for Agricultural Production Firms, Tampa FL, March 1986. Proceedings published by Dep.

Pratt, John W. "Risk Aversion in the Small and in the Large". Econometrica 32(1964):122-136.

Raup, Philip M. "Use of Equity Capital in Financing Future Agricultural Production: Discussion." American Journal of Agricultural Economics 68(1986):1337-1339.

United States Government Printing Office. <u>Economic Report of the President</u>. January, 1989.

Young, Renna P. and Peter J. Barry. "Holding Financial Assets as a Risk Response: A portfolio Analysis of Illinois Grain Farms." <u>North Central Journal of Agricultural Economics</u> 9(1987):77-84.

Wiesenberger Financial Services. <u>Wiesenberger Investment Companies Service</u>. Warren, Gorham & Lamont, Inc., New York. Several issues.

Table 1. **Expectational Equations for Ten Stochastic Variables used in the Model[a]. The Subscripts on the variables refer to the time period.**

Inflation Rate

$$GNPDEF_t = \underset{(0.01261076)}{-0.00792198} + \underset{(0.13632)}{0.6894860}\ GNPDEF_{t-1} + \underset{(0.08632881)}{0.3219046}\ M2GRATE_{t-3}$$

$$+ \underset{(0.001134069)}{0.002733086}\ TBILLL3M_{t-1}$$

$$\bar{R}^2 = 0.77$$

Money Growth Rate

$$M2GRATE_t = M2GRATE_{t-1} + error_{mg}$$

Three-Month Treasury Bill

$$TBILL3M_t = \underset{(1.119661)}{0.6241057} + \underset{(0.1870224)}{0.3917148}\ TBILL3M_{t-1} + \underset{(8.345410)}{20.84175}\ M2GRATE_{t-2}$$

$$- \underset{(1.008574)}{3.043348}\ DUM$$

$$\bar{R}^2 = 0.84$$

Return to the Mutual Fund

$$STOCKRTN_t = \underset{(0.07479)}{-0.147004} + \underset{(0.003241513)}{0.003203346}\ STOCKPCE_{t-2} + \underset{(0.001278848)}{0.01125524}\ TREND$$

$$\bar{R}^2 = 0.42$$

Cotton Yield

$$COTTONYLD_t = COTTONYLD_{t-1} + error_{cy}$$

Cotton Price

$$COTTONPCE_t = COTTONPCE_{t-1} + error_{cp}$$

Wheat Yield

$$WHEATYLD_t = \underset{(3.3434)}{20.91729} + \underset{(0.1721651)}{0.7737568}\ TREND - \underset{(0.1942425)}{0.6214804}\ WHEATYLD_{t-1}$$

$$\bar{R}^2 = 0.53$$

Table 1 continued...

Wheat Price

$$WHEATPCE_t = \underset{(2.125317)}{7.683158} + \underset{(0.1689838)}{0.4605737}\ WHEATPCE_{t-1} - \underset{(0.0489396)}{0.1521963}\ WHEATPCE_{t-2} - \underset{(0.0560054)}{0.1206894}\ WHEATPCE_{t-3}$$

$$\bar{R}^2 = 0.62$$

Land Price

$$LANDPCE_t = \underset{(63.6614)}{111.2703} + \underset{(0.1476917)}{0.6812731}\ LANDPCE_{t-1} + \underset{(303.9483)}{557.3488}\ GNPRATE_{t-1}$$

$$\bar{R}^2 = 0.66$$

Stock Price

$$STOCKPCE_t = \underset{(1.265345)}{3.333961} + \underset{(0.1685018)}{0.4603531}\ STOCKPCE_{t-1} + \underset{(0.1244510)}{0.2515296}\ STOCKPCE_{t-3}$$

$$\bar{R}^2 = 0.94$$

[a]**Variable Definitions**

GNPDEF = percentage change in the gross national product implicit price deflator in time t,

M2GRATE = growth rate in the M2 money supply,

TBILL3M = real return on a 3-month treasury bill,

STOCKRTN = return on the Massachusetts Investors Trust mutual fund (dollars/share)

COTTONYLD = cotton yield (pounds/acre)

COTTONPCE = cotton price (cents/pound)

WHEATYLD = wheat yield (bushels/acre)

WHEATPCE = wheat price (dollars/bushel)

LANDPCE = land price (dollars/acre)

STOCKPCE = price of the Massachusetts Investors Trust mutual fund stock (dollars/share)

Table 2. Descriptive Statistics of the States of Nature for the Stochastic Variables Used in the DSP Model. (All dollar values are nominal).

Year	Mean	Standard Deviation	Minimum	Maximum
		Price of Land (dollars/acre)		
1	439.27	21.75	415.41	472.99
2	464.87	34.64	389.02	522.77
3	476.12	40.84	395.07	553.01
4	504.36	51.20	403.10	635.76
5	532.80	79.60	378.31	696.66
		Price of Stock (dollars/share)		
1	12.99	1.79	10.13	15.19
2	13.63	1.85	8.86	17.52
3	14.07	2.34	9.45	18.68
4	14.92	3.03	8.64	20.69
5	15.61	3.32	8.45	23.09
		Interest on Debt		
1	.115	.024	.08	.14
2	.126	.019	.08	.16
3	.135	.028	.09	.19
4	.138	.041	.07	.23
5	.144	.043	.07	.23

Year	Mean	Standard Deviation	Minimum	Maximum
		Farm Return to the Operator (dollars/acre)		
1	37.94	19.60	9.23	66.48
2	35.50	25.27	-11.66	78.28
3	37.64	32.39	-26.53	108.75
4	39.08	30.70	-32.22	107.85
5	44.53	34.09	-30.05	132.12
		Farm Return to the Landowner (dollars/acre)		
1	43.70	7.00	32.99	53.80
2	43.95	8.38	28.85	59.12
3	46.30	10.93	23.53	70.16
4	48.39	10.17	25.64	71.66
5	51.85	11.75	26.36	80.92
		Return to Stock		
1	.118	.025	.08	.15
2	.136	.026	.08	.18
3	.143	.029	.09	.20
4	.166	.043	.10	.26
5	.177	.038	.11	.25
		Return on Certificates of Deposit		
1	.065	.024	.03	.09
2	.076	.019	.03	.11
3	.085	.028	.04	.14
4	.088	.041	.02	.18
5	.094	.043	.02	.18

Table 3. Investment Alternatives Simulated in the Model.

Scenario	Land Owned (acres)	Stocks	CDs	Land Operated (acres)	Initial Equity (dollars)	Initial Debt (dollars)
1	250	No	Yes	500	75,000	32,500
2	≥ 250	No	Yes	500	75,000	32,500
3	250	Yes	Yes	500	75,000	32,500
4	≥ 250	Yes	Yes	500	75,000	32,500
5	20	Yes	Yes	500	75,000	0
6	≥ 20	Yes	Yes	500	75,000	0
7	≥ 20	No	Yes	500	75,000	0

Table 4. Certainty Equivalents for the Different Investment Scenarios Solved at Selected Risk Aversion Levels ($ 1,000s).

Risk Level[b]	Scenario[a]: [1]	[2]	[3]	[4]	[5]	[6]	[7]
0.0001	72.15	73.84	119.67	119.89	128.99	130.41	76.65
0.00009	75.14	76.96	123.23	123.66	133.33	135.14	79.60
0.00008	78.65	80.61	126.67	127.06	138.74	140.41	83.02
0.00007	82.78	84.87	130.26	130.93	142.45	144.67	86.98
0.00006	87.62	89.88	134.23	135.06	146.52	149.04	91.57
0.00005	93.29	95.70	138.71	139.68	150.37	153.20	96.86
0.00004	99.79	102.36	143.93	145.17	154.66	157.72	102.85
0.00003	107.02	109.80	149.95	151.45	159.56	162.88	109.52
0.00002	114.71	117.84	156.85	158.70	165.31	168.98	116.79
0.00001	122.46	126.26	164.74	167.18	172.28	176.50	124.52
0.000009	123.22	127.12	165.61	168.10	173.06	177.34	125.32

[a]See Table 3

[b]Pratt Risk Aversion Parameter

Table 5. Average Portfolio Composition of the Investment Alternative that Holds at Least 250 Acres of Land, and No Mutual Funds.

	Land	Stock	CDs	Total
		Medium Risk Level		
Beginning of				
Year 1	115,058 (100.00%)	0 (0%)	0 (0%)	115,058 (100.00%)
Year 2	151,664 (100.00%)	0 (0%)	0 (0%)	151,664 (100.00%)
Year 3	179,449 (97.96%)	0 (0%)	3,743 (2.04%)	183,192 (100.00%)
Year 4	255,633 (99.39%)	0 (0%)	1,570 (0.61%)	257,203 (100.00%)
Year 5	207,366 (97.77%)	0 (0%)	4,738 (2.23%)	212,104 (100.00)

Table 6. Average Portfolio Composition of the Investment Alternative that Holds at Least 250 Acres of Land, and Some Mutual Funds.

	Land	Stock	CDs	Total
		Medium Risk Level		
Beginning of				
Year 1	107,420 (72.09%)	41,580 (27.91%)	0 (0%)	149,000 (100.00%)
Year 2	135,082 (48.99%)	140,637 (51.01%)	0 (0%)	275,719 (100.00%)
Year 3	159,264 (45.18%)	175,332 (49.74%)	17,926 (5.08%)	352,522 (100.00%)
Year 4	184,418 (42.08%)	241,290 (55.05%)	12,574 (2.87%)	438,282 (100.00%)
Year 5	175,943 (43.31%)	202,767 (49.91%)	27,554 (6.78)	406,264 (100.00)

Table 7. Average Portfolio Composition of the Investment Alternative that Holds at Least 20 Acres of Land, and Some Mutual Funds.

	Land	Stock	CDs	Total
		Medium Risk Level		
Beginning of				
Year 1	8,594 (5.79%)	139,906 (94.21%)	0 (0%)	148,500 (100.00%)
Year 2	81,390 (33.66%)	160,388 (66.39%)	0 (0%)	241,778 (100.00%)
Year 3	87,774 (27.21%)	213,222 (66.11%)	21,545 (6.68%)	322,541 (100.00%)
Year 4	92,297 (22.95%)	282,843 (70.32%)	27,080 (6.73%)	402,220 (100.00%)
Year 5	82,242 (22.20%)	250,069 (67.49%)	38,202 (10.31)	370,513 (100.00)

Figure 1. Coefficients of Variation of Ending Wealth Plotted Against Risk Aversion Parameters for Selected Investment Scenarios.

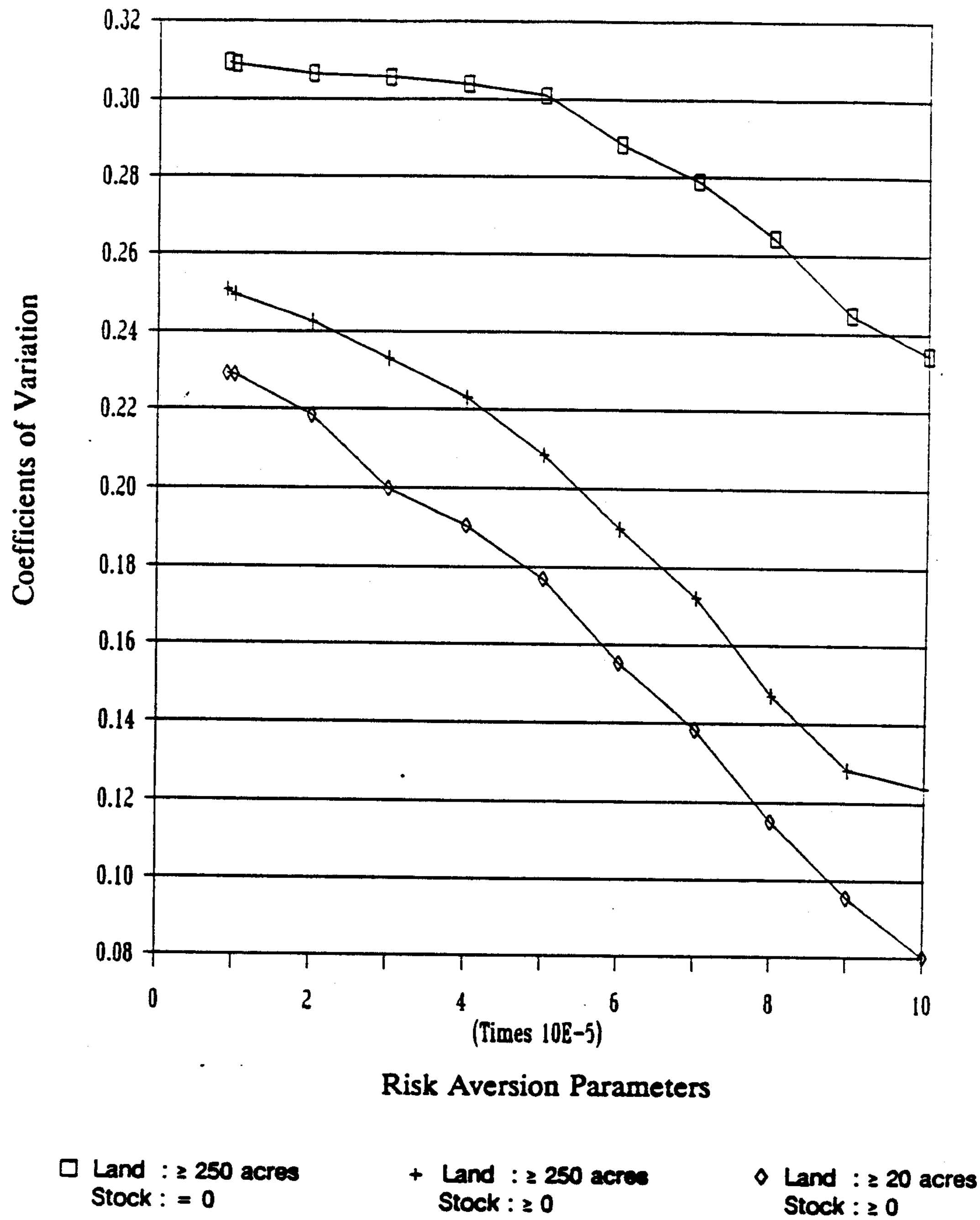

Figure 2. Cumulative Probability Distributions of Ending Wealth for Two Investment Scenarios (Pratt Risk Aversion Parameter = 0.00005).