Financial and Real Estate Investments in Mixed-Asset Agricultural Portfolios

By James D. Libbin, Jeremy D. Kohler, and Jerry M. Hawkes

Abstract

The concepts of diversified portfolios common to financial market investors are applied to a farm setting. This study evaluates the effect on farm portfolio values of using available cash generated from the farm to diversify financially. The financial strategies included alternative debt management strategies, cash investments, and equity investments.

Models of 10 representative New Mexico farms were used in this study. Historical cost and return estimates were used to determine annual net cash income for each farm model from 1989 through 2001. Excess cash, beyond operating and family living requirements, was used to purchase shares of a money market fund, a mutual fund, and several publicly-traded agricultural companies.

Many of the farm models could not generate sufficient cash flow at any level of debt without outside income; therefore, these farms could not consider any financial investment strategies. For those farms that could cash flow, debt management and financial investments had favorable effects on portfolio values. Although portfolio values were increased from the various financial investments, there was no indication of major diversification benefits.

Production agriculture is a capital-intensive venture that bears many elements of uncertainty; therefore, producers must tolerate a substantial amount of risk and combat many challenges within their preferred livelihood. Many farmers are constrained to small amounts of income and free cash flow, although they may build equity with the appreciation of land values. An old adage says that farmers live poor and die rich. Although land is an almost perfect inflation hedge and builds substantial wealth over the lifetime of the landowner, that wealth accumulation cannot be spent without selling the land itself. Nonetheless, the successful and often older producers, especially those who inherit land or otherwise do not have to repay land notes, who generate a significant amount of income may perhaps expand their operations or consider strategies to diversify and protect their interests and lifestyle. Given the nature of the business, if farmers are able to generate investable funds, what options exist for them?

Libbin is a professor of agricultural economics and agricultural business and extension farm management specialist at New Mexico State University and a Secretary-Treasurer of the New Mexico Chapter of the American Society of Farm Managers and Rural Appraisers.

Kohler is a Commodites Broker for Insight Financial Group in Denver, Colorado.

Hawkes is a college assistant professor of agricultural economics and agricultural business at New MExico State University.

Diversification plays a very important role in many aspects of financial decision-making. Diversification may be defined as spreading risk among many assets to offset changes in markets that will not likely react similarly to economic or financial news and phenomena (Brigham & Ehrhardt, 2002). Historically, agricultural producers may not have considered diversification in the same manner that typical financial investors may. Agricultural producers often look at diversification as changing their crop mix, rotational system, livestock breeds, or even purchasing another operation several miles away for geographic diversification. None of these actions consistently fit the definition of diversification from a purely financial perspective; some may even increase risk. Commodity yields and prices have a tendency to trend together, and producers are still subject to the same uncontrollable market forces and weather conditions if they expand within the same set of crops or within the same general geographic area. Given this, crop mixes and rotations may not result in an effective diversification strategy to lessen the actual underlying risk, and in fact if yields tend to trend together, if prices tend to trend together, and/or if yields and prices tend to trend together, whole-farm risk may actually increase. Moreover, expanding geographically may spread fixed costs over more acres and generate larger gross returns; however, this may lead to inefficiencies in labor and managerial resources as well as increase mileage on equipment given the scale of the operation and ultimately increase fixed costs and may increase rather than reduce risk. So, how should a farmer truly diversify?

This article will not recommend that producers sell the farm and invest the proceeds entirely in the domestic stock market or any other investment market, but rather should consider opportunities to increase overall portfolio value by investing a portion of operating profit in financial assets and diversifying across asset classes. Diversifying in this manner may provide farm owner/investors with greater returns on their investment opposed to production agriculture alone, while allowing the producer to continue with the chosen lifestyle in the agricultural environment.

Objectives and Procedures

The overall objective of this report is to evaluate economic and financial options and possibilities of financial diversification of a traditional production agriculture enterprise. The risk and return of the portfolio will be analyzed, while allowing the producer to maintain control of the primary real asset, the farm.

The economic and financial analyses will include both primary and secondary data. New Mexico State University cost and return estimates (e.g., Hawkes and Libbin, 2000) will be used to develop historical disposable income levels for ten separate representative farm models representing different crop mixes, irrigation methods, and geographic areas throughout New Mexico. The first step in addressing these questions was to develop a set of historical cash-based cost and return estimates from individual crop cost and return estimates throughout New Mexico. Secondly, risk and return data were collected on 50 publicly-held agricultural companies (Value Line Investment Survey 1989-2001), a money market fund, and an agriculturally-oriented mutual fund. Because investors often prefer putting their money into a market or company that holds similar interests to those that they hold or that they are familiar with, and because there may be covariance gains (through risk reduction), agricultural companies were chosen.

Portfolio Theory

The nature of each investor and the objectives of investors may differ, although Markowitz (1959) identifies two objectives common to all investors:

1. They want returns to be high. The appropriate definition of return may vary from investor to investor. But, in whatever sense is appropriate, they prefer more to less.

2. They want this return to be dependable, stable, not subject to uncertainty; i.e., they prefer certainty to uncertainty.

A good portfolio is more than a large combination of securities. It is balanced as a whole with the intent of providing the investor with protections and opportunities under a wide range of possibilities. Investors should build portfolios tailored to their individual needs. Developing portfolios begins with information on individual assets and ends as a mixed whole.

Portfolio Risk

Risk can be a difficult concept to grasp; there has not been a universal agreement on how to define and measure it in a portfolio context. Risk can be separated into both market risk and stand-alone risk. Any asset's risk is equal to its market risk plus its stand-alone risk. Diversifiable (stand-alone) risk is affected by factors associated with a particular asset and can be nearly eliminated by diversification. Market risk stems from factors such as inflation, recession, business cycles, or interest rates and cannot be eliminated by diversification. A more exhaustive (some may say exhausting) review of portfolio risk research related to mixed-asset portfolios - those that include financial instruments and real estate - can be found in a companion article in this Journal (Libbin, Kohler, and Hawkes 2004).

Data and Methods

Enterprise cost and return estimates (CAREs) include all of the cost and returns associated with producing a particular enterprise and provide the basic information for making farm management decisions. Ten of the forty-nine separate NMSU representative farm models were selected for this study. Historical crop cost and return estimates were used on each of the farm models from the years 1989 through 2001, to include estimates for a thirteen-year period. These representative farms were selected to encompass different geographic locations throughout the state of New Mexico, various crop types (enterprises) and crop mixes, alternative irrigation methods, and varying farm sizes. The crop CAREs are typically identified by county or particular regions in a county. Table 1 lists and briefly describes each of the farm models used in the analysis.

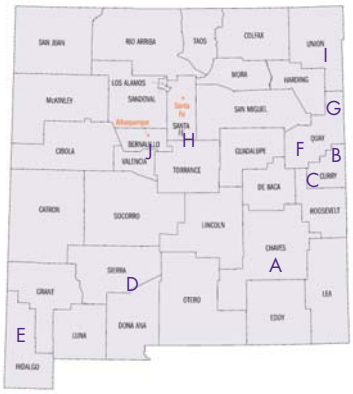
NMSU enterprise CAREs include both cash and non-cash expenses to account for the value of all resources used in the production process. This means that both explicit and implicit costs are used in the development of the CAREs, or better stated, they generate economic costs and returns. Economic costs include both explicit cash expenses as well as opportunity costs. For cash flow planning purposes and to determine the amount of available disposable cash income, it was necessary to remove all non-cash expenses (including depreciation, value of owner-operator labor and management, and cost of capital from the enterprise CAREs) to provide strictly cash-based estimates. Once the annual net cash income was determined for each farm model, detailed spreadsheets were developed to include different financial strategies for utilizing the amount of excess cash, which exceeded the level necessary for continued production. Each strategy was evaluated over the entire period from 1989 through 2001 to observe how each affected owner's equity, which can be called portfolio value.

Table 1. Representative Farm Models

Farm	Farm Size	Per Acre Land Value	Irrigation Type	# of Crops	Crops Grown
A. Chaves County (Artesia-Lake Arthur Area)	500 acres	$3,250	Flood	6	Alfalfa, Barley, Oat Hay, Picker Cotton, Stripper Cotton, Red Chile
B. Curry County	1,600 acres	$225	Dryland	2	Wheat, Grain Sorghum
C. Curry County	640 acres	$1,500	Sprinkler	2	Wheat, Corn
D. Doña Ana & Sierra Counties	500 acres	$7,000	Flood	12	Alfalfa, Pima Cotton, Upland Cotton, Grain Sorghum, Spring Lettuce, Fall Lettuce, Wheat, Fall Onions, Midseason Yellow Onions, Sweet Spanish Onions, Green Chile, Red Chile
E. Hidalgo County (Cotton City-Animas Area)	400 acres	$1,000	Flood/Sprinkler	4	Grain Sorghum, Cotton, Green Chile, Red Chile
F. Quay County (Arch Hurley Conservancy District)	600 acres	$700	Sprinkler	3	Alfalfa, Grain Sorghum, Wheat
G. Quay County (San Jon-Nara Visa Area)	800 acres	$525	Dryland	3	Alfalfa, Grain Sorghum, Wheat
H. Torrance & Santa Fe Counties (Estancia Basin)	160 acres	$1,125	Flood	3	Alfalfa, Corn, Pinto Beans
I. Union County	1,280 acres	$1,000	Sprinkler	5	Alfalfa, Wheat, Corn, Grain Sorghum, Haygrazer
J. Valencia & Southern Bernalillo Counties	30 acres	$8,750	Flood	5	Alfalfa, Oat Hay, Sorghum Hay, Green Chile, Jalapeños

Each model was built to include five main parts: a section used to enter certain values directly from each enterprise CARE, a balance sheet, an amortization schedule, income tax calculations, and a cash flow summary. Various financial scenarios were built and articulated year to year from 1989 to 2001 to observe and compare the effect of each strategy on portfolio value with various debt loads. Additionally, farm betas were calculated with the S&P 500 used as the market proxy.[1]

Figure 1. New Mexico Representative Farms



A land value index was created using New Mexico land value estimates published by the USDA. The beginning 1989 total farm values were indexed annually to show changes in land market values. Land values were included in the balance sheet and, along with land interest rates, were necessary for developing the amortization schedule. Machinery values (at market) were included in the balance sheet as well as the amortization schedule, along with machinery interest rates.

The balance sheet was developed to specifically determine owner's equity or portfolio value. It was divided into current or short-term assets and liabilities as well as long-term assets and liabilities. For all farm models, it was assumed that beginning cash was $10,000. Throughout the models, at least $10,000 cash was assumed to be maintained for operating purposes, even if it had to be borrowed in the short term. Liquid investments were calculated to be total shares times the beginning of year price per share. For all investment strategies, no liquid investments were purchased until the end of 1989, since it required at least one year to generate investable cash. Therefore, liquid investments will not appear before the beginning of 1990. Long-term assets include land and machinery.

The only short-term liability listed was principal on operating loans. Operating loans were taken only if ending cash from the previous year was less than $10,000 since that was the amount always retained for operating cash. Operating loans, if required, will not appear until the 1990 balance sheet. The long-term liabilities included the principal on machinery and land. These liabilities were calculated within the amortization schedule, which will be discussed next. Owner's equity is simply total assets minus total liabilities.

It was assumed that land and machinery were purchased at the beginning of 1989 and that all or a portion of the purchase price for both land and machinery had to be borrowed. The purchase price for machinery was the same as the beginning of year machinery value. The principal portion that had to be financed was calculated as the purchase price times the debt load of the farm. For example, if the debt load were 50 percent, then half of the purchase price would have had to be borrowed. The interest rate on machinery was fixed at the 1989 interest rate and the term of the loan was seven years, with seven equal annual payments; the last payment made in 1995. Equipment does depreciate and it has to be replaced. As a result, the amortization schedule also shows the principal and interest portion for annual equipment replacement. The amount to be replaced was equal to the equipment value in year t minus the equipment value in year t-1 minus the amount of depreciation in year t-1. Again, the amount borrowed depends upon the debt scenario, and the entire principal and interest portions of machinery and equipment replacement were repaid each year. Unlike the fixed interest rate for machinery purchase, the interest rate for machinery and equipment replacement changed each year. The amount of machinery and equipment replacement that was not borrowed was paid in cash.

The purchase price for land was the same as the beginning land value. As was the case for machinery, the land principal was calculated by multiplying the purchase price times the debt load. The interest rate on land was assumed to be variable, so the remaining principal at the beginning of each year was refinanced at a new interest rate. The term for the land loan was thirty years and the annual payments were not equal due to the variable interest rate.

Income from investments came from the cash flow summary and was calculated as the total number of shares held of each investment times the annual dividends paid per share. Net farm cash income came from the cash-based CAREs. Depreciation came from the enterprise CARE data. Interest expense was calculated as the sum of the interest portions paid on machinery purchase, machinery replacement, and land purchase. Both depreciation and interest expense were deducted from net cash income to derive net farm profit. Standard deduction, personal exemptions, self-employment tax, and personal income tax were all calculated using each year's appropriate federal tax laws to determine each year's total tax liability. Each farm was assumed to support a family of four.

The cash flow summary included all cash flows that were received and all cash flows that were paid out in order to calculate annual net cash flow for each farm model. Net cash income and investment incomes were the cash inflows. Interest expenses and taxes were subtracted from total cash income to determine net income. Return on equity was calculated by dividing net income by owner's equity and is the percentage

return used to calculate each farm beta. This was calculated on both a cash and market basis. The market basis not only includes net income as return, but also the amount of land appreciation from the previous year. The amount of equipment replacement that was not borrowed and accounted for in the amortization schedule was reflected as a cash expense. The value of family living withdrawals was taken from a publication of the Illinois Farm Business Farm Management Association (Lattz et al., 2002) to represent annual family living expenses. These family living withdrawals were indexed using the consumer price index with 1991 as the base year. Business principal was removed from net income to determine net cash flow. Beginning cash plus net cash flow determined ending cash, which established the amount of cash to be utilized for each alternative financial strategy.

Financial Strategies and Debt Load Levels

Because many farmers indicate their desire to be free of debt, the first strategy for the use of cash generated by the farm (over and above the amount needed for normal debt service, family living expenditures, tax payments, and operating expenses) was to repay land principal in excess of required payment levels. This strategy is not really an investment strategy, however, it is consistent with an often-mentioned goal of farmers. Eight investment strategies ranging from simplistic to sophisticated portfolio strategies were devised. The first two are cash or money market strategies and the remaining six used equity instruments. In total, nine separate strategies were considered for the allocation of excess cash (these nine selected strategies are listed briefly in table 2 and will be described in detail shortly).

Table 2. Selected Financial Strategies for Use of Excess Cash

1. Repay debt
2. Retain cash
3. Money market
4. Mutual fund
5. Naïve portfolio
6. Efficient portfolio
7. Input stocks
8. Output stocks
9. Input/Output stocks

Regardless of the amount of net cash income or net cash flow, at least $10,000 was retained each year for operating purposes; consequently, beginning cash (shown in the balance sheet) never falls below $10,000, which is also the amount assumed for 1989 beginning cash. If ending cash for any year exceeded $10,000 then that amount greater than $10,000 was allocated for some other use rather than retaining it as cash. If ending cash was less than $10,000 then the cash was maintained and a short-term operating loan was taken to total $10,000 in operating cash.

The maximum debt load for each farm model was determined by forcing ending cash in 2001 (or beginning cash 2002) to equal beginning cash in 1989. This calculated the maximum debt or how leveraged each farm could be in order to just cash over the entire thirteen-year period, and determined if the farm could provide enough free cash flow to consider any diversification strategies. If it was found that the farm could sustain a debt load, each of the nine financial strategies were evaluated up to, but not beyond, the maximum debt load in 25 percent increments. Thus, each financial strategy was evaluated at 0, 25, 50, and 100 percent debt loads up to the maximum debt load to determine which strategy was most effective in maximizing portfolio value. Each strategy was evaluated separately, i.e., there were no scenarios that considered investing cash into a combination of the strategies. The goal of the entire process was to maximize ending net worth; the nine financial strategies are evaluated against that standard.

The first financial strategy evaluated for each farm model was to use any excess cash generated by the farm to repay land principal beyond annual obligation. The next financial strategy evaluated for each model was to retain all excess cash in the form of cash. With this approach, any cash that was generated within a particular year was simply retained and carried forward to the next year. The money market strategy used excess cash to purchase shares of the Fidelity Select Money Market fund. There are hundreds of different money market funds, and there was no specific reason for using this fund other than the fact that it began in 1985 and was traded throughout all thirteen years of this analysis, consists entirely of cash and equivalents, and is assigned a moderate ranking of three stars (5 highest; 1 lowest). It may also be convenient to use the same investment firm that manages the chosen mutual fund. The mutual fund

strategy considered allocating any excess cash into the Fidelity Select Food & Agriculture mutual fund. This mutual fund is the only specifically agriculturally-oriented mutual fund. It also began in 1985 and was traded during all years considered in this model.

A naïve portfolio of stocks is a collection of stocks that have not been evaluated based upon any risk or return measures or any other statistical analysis or performance criteria; it is simply a selection (sample) of stocks from a population of stocks. Information on 50 publicly-traded agricultural firms from different sectors was collected from The Value Line Investment Survey. For this study, as was the case for the money market fund and mutual fund, all shares of stock purchased at the end of any year remained in the portfolio throughout the entire time period. Therefore, for simplicity, firms were only chosen if they were traded during all years from 1989 through 2001 to avoid the complication of mergers, acquisitions, initial public offerings, or other major events. Beginning stock price, ending stock price, and dividends declared were collected for each firm during each year of the analysis. From this data, annual total return was calculated for each stock, which included both dividends and capital gains or losses.

All 50 stocks were used to construct the naïve portfolio for this strategy. For that reason, all available cash was divided equally to purchase shares of stock of each firm, i.e., 2 percent of each year's excess cash was invested in each firm. Round lot purchasing was ignored. Once more, investment income was determined by the total number of shares held of each firm multiplied by the annual dividends of each share. Table 2 lists all firms used in the construction of the naïve portfolio and includes the calculated mean return and standard deviation of returns of each stock throughout the entire period of the analysis. The beta coefficients are the Value Line reported betas.[2]

Efficient portfolios provide the highest return for any degree of risk, or the lowest degree of risk for any return. With that in mind, an efficient set of stocks was chosen from the available set of 50 stocks. A scatter plot was created to illustrate the efficient frontier by plotting each stock's risk and return profile. The efficient frontier, or efficient set, included five stocks (McCormick & Co., Wrigley Co., Winn-Dixie Stores, Merck & Co., and Pfizer Inc.) that dominated all other stocks since they offered a higher return for any degree of risk or a lower degree of risk for any return. Figure 2 shows the risk and return profile for all 50 stocks and labels the efficient set. Given that the efficient set was made up of five stocks, all excess cash was divided equally and invested in each of those individual stocks.

Table 1. Representative Farm Models

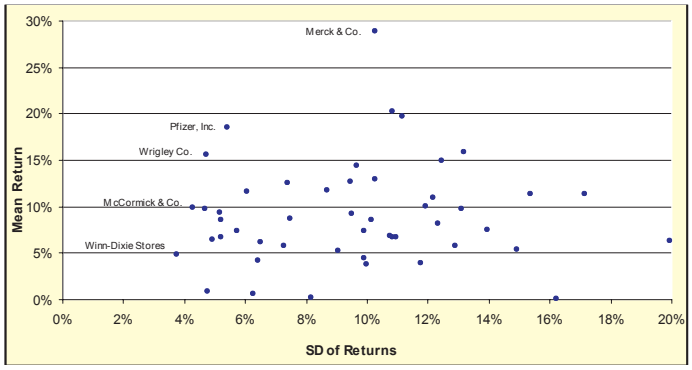
Sector	Firm	Symbol	Mean Return	SD Returns	Beta
Paper & Forest Products	Boise Cascade Corp.	BCC	3.79%	9.97%	1.2
	Glatfelter	GLT	7.55%	13.94%	0.75
	International Paper	IP	4.00%	11.74%	1
	Longview Fibre	LFB	6.92%	10.74%	0.9
	Potlatch Corp.	PCH	6.49%	4.90%	0.9
	Wausau-Mosinee Paper Corp.	WMO	8.59%	5.16%	1
	Weyerhaeuser Corp.	WY	5.78%	12.89%	1.05
Chemical	Dupont	DD	6.41%	19.90%	1
	Norsk Hydro	ADR	5.46%	14.88%	0.75
Machinery	Caterpillar Inc.	CAT	8.69%	10.14%	1.15
	Deere & Co.	DE	8.21%	12.32%	1.05
Food Processing	Archer Daniels Midland	ADM	11.43%	17.14%	0.7
	Campbell Soup	CPB	8.79%	7.46%	0.65
	Dole Food Co., Inc.	DOL	5.87%	7.23%	0.75
	Dreyer's Grand Ice Cream	DRYR	14.43%	9.65%	0.85
	Heinz (H.J.) Co.	HNZ	9.48%	5.15%	0.55
	Hershey Foods	HSY	11.66%	6.03%	0.6
	Hormel Foods	HRL	6.80%	5.18%	0.55
	International Multifoods Corp.	IMC	4.19%	6.41%	0.6
	Kellog Co.	K	12.68%	7.38%	0.6
	Lance, Inc.	LNCE	9.83%	4.67%	0.55
	McCormick & Co.	MKC	10.02%	4.27%	0.5
	Pilgrim's Pride Corp.	CHX	11.46%	15.33%	0.7
	Sara Lee Corp.	SLE	7.40%	5.70%	0.6
	Sensient Technologies	SXT	4.56%	9.89%	0.65
	Smithfield Foods Inc.	SFD	14.03%	20.75%	0.9
	Smucker (J.M.) Co.	SJM	9.35%	9.46%	0.6
	Tasty Baking Co.	TBC	0.18%	16.18%	0.45
	Tootsie Roll Industries	TR	12.79%	9.44%	0.65
	Tyson Foods Inc.	TSN	9.88%	13.09%	0.8
	Unilever N.V.	UN	6.77%	10.95%	0.75
	Unilever PLC	UL	6.75%	10.80%	0.75
	Wrigley Co.	WWY	15.64%	4.72%	0.75
Grocery Store	Albertson's, Inc.	ABS	11.82%	8.68%	0.65
	Casey's General Stores	CASY	13.04%	10.24%	0.65
	Great Atlantic & Pacific	GAP	0.91%	4.73%	0.75
	Kroger Co.	KR	0.71%	6.22%	0.8
	Ruddick Corp.	RDK	6.30%	6.49%	0.65
	Weis Markets	WMK	10.99%	12.15%	0.6
	Winn-Dixie Stores	WIN	4.90%	3.72%	0.75
Food Wholesalers	Fleming Companies	FLM	0.28%	8.14%	0.7
	Nash Finch Co.	NAFC	5.27%	9.04%	0.55
	Supervalu, Inc.	SVU	7.40%	9.88%	0.75
	Sysco Corp.	SYY	15.00%	12.42%	0.8
Drug/Animal Health	Lilly (Eli) & Co.	LLY	19.78%	11.14%	0.85
	Merck & Co.	MRK	28.89%	10.26%	0.95
	Pfizer, Inc.	PFE	18.63%	5.37%	0.95
Bank	Bank of America Corp.	BAC	15.88%	13.17%	1.3
	Union Planters Corp.	UPC	10.10%	11.92%	1
	Wells Fargo & Co.	WFC	20.38%	10.82%	1.1

Investing in input firms consisted of purchasing shares of stock of those firms that produce products or provide services that a farm may use in their operation. On the other hand, investing in output firms included purchasing shares of stock of those firms that purchase and/or process products produced on the farm. Five firms were selected as farm input firms (Dupont, Caterpillar, Deere & Co., Union Planters, and Wells Fargo), and five firms were chosen as farm output firms (Archer Daniels Midland, Dole Food, International Multifoods, McCormick & Co., and Unilever). Accordingly, 20 percent of available cash

Table 3. Efficient Frontier (1989 – 2001)

Farm Model	Beginning Cash	Beginning Machinery Value	Beginning Land Value	Total Beginning Assets	Maximum Debt Load	Portfolio Beta @ Maximum Debt Load	
						Cash	Market
Chaves 500 Flood	$10,000	$228,205	$1,625,000	$1,863,205	44.66%	0.005	0.079
Curry 1,600 Dryland	$10,000	$103,700	$360,000	$473,700	-73.24%	0.065	0.093
Curry 640 Sprinkler	$10,000	$141,340	$960,000	$1,111,340	-11.88%	0.045	0.087
Doña Ana & Sierra 500 Flood	$10,000	$155,590	$3,500,000	$3,665,590	44.22%	0.019	0.098
Hidalgo 400 Flood/Sprinkler	$10,000	$157,425	$400,000	$567,425	10.45%	-0.036	0.007
Quay 600 Sprinkler	$10,000	$87,595	$420,000	$517,595	75.57%	0.107	0.219
Quay 800 Dryland	$10,000	$103,095	$420,000	$533,095	-236.26%	0.013	0.029
Torrance & Santa Fe 160 Flood	$10,000	$71,850	$180,000	$261,850	-723.22%	-0.004	0.003
Union 1,280 Sprinkler	$10,000	$350,690	$1,280,000	$1,640,690	95.38%	-0.005	0.204
Valencia & S. Bernalillo 30 Flood	$10,000	$7,850	$262,500	$280,350	-190.47%	0	0.019

Figure 2. Efficient Frontier (1989 – 2001)



was invested in each input firm, and 20 percent of available cash was invested in each output firm for each farm model. The final financial strategy equally combined investments in the selected input and output firms; thus, 10 percent of investable cash was used to purchase stock in each of the 10 firms for each farm model.

Results

Since the primary objective of this study was to evaluate how each of the nine alternative financial strategies affected owner's equity (portfolio value), most of the presented results came from the balance sheet section of the models. Before evaluating each strategy at different debt levels, it was necessary to determine the maximum debt load that each farm model could sustain. Table 3 includes the beginning value of assets (beginning of 1989) and the maximum debt load for each model along with the portfolio betas calculated on a cash and market basis. It was assumed that each farm began with $10,000 in cash; thus, beginning cash for all farm models is equal to $10,000. Other beginning values shown in Table 3 were taken from the various cost and return estimates. The beginning machinery value and beginning land value represent the total value of long-term assets. The combined initial value of land and machinery times the debt load represents the initial amount of long-term liabilities for each model. Total beginning assets includes the value of machinery and land plus the $10,000 in beginning cash. The maximum debt load was determined using the goal seek procedure in Microsoft Excel Version 2000 and represents the maximum amount each farm model could finance and provide sufficient cash flow.

Only five of the ten farm models could sustain any debt load at all. The remaining models had negative maximum debt loads, which means that those farms could not generate enough free cash flow (cash flow over production and family obligations) to consider any diversification alternatives. In fact, they had to continually borrow short-term operating loans just to maintain $10,000 in annual operating cash. Portfolio betas were calculated at the maximum debt load for each model. The market beta included land appreciation as part of annual return. Cash basis portfolio betas excluded non-cash appreciation of land. All computed betas were virtually zero or very close to zero.

For those farm models that could sustain a debt load, each of the nine financial strategies was evaluated up to, but not beyond, the maximum debt load in 25 percent increments to determine the effect on portfolio value. The summarized results list and rank each financial strategy for each model by the percentage growth in portfolio value. This was done for each of

Table 4. Chaves 500-Acre Flood: Selected Balance Sheet Values

	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta 0% Debt Cash	Farm Portfolio Beta 0% Debt Market	Portfolio Growth	Rank	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta 25% Debt Cash	Farm Portfolio Beta 25% Debt Market	Portfolio Growth	Rank
Repay Debt	$3,544,015	0	0.012	0.055	52.76%	8	$2,871,273	0	0.009	0.065	55.25%	5
Retain Cash	$3,544,015	0	0.012	0.055	52.76%	9	$2,743,173	0.11	0.012	0.068	46.10%	9
Money Market	$3,690,011	0	0.01	0.053	60.59%	7	$2,798,989	0.11	0.009	0.065	50.09%	8
Mutual Fund	$3,736,316	0	0.011	0.054	63.08%	6	$2,801,439	0.11	0.011	0.068	50.27%	7
Naïve Portfolio	$3,970,571	0	0.01	0.054	75.65%	4	$2,896,884	0.1	0.01	0.067	57.08%	3
Efficient Portfolio	$4,711,035	0	0.008	0.051	115.39%	1	$3,197,896	0.09	0.008	0.064	78.59%	1
Input Stocks	$4,097,647	0	0.009	0.052	82.47%	2	$2,935,399	0.1	0.008	0.065	59.84%	2
Output Stocks	$3,855,908	0	0.011	0.054	69.50%	5	$2,856,904	0.1	0.011	0.067	54.23%	6
Input/Output Stocks	$3,976,807	0	0.009	0.053	75.98%	3	$2,896,029	0.1	0.01	0.066	57.02%	4

Table 5. Dona Ana and Sierra 500-Acre Flood: Selected Balance Sheet Values

	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta 0% Debt Cash	Farm Portfolio Beta 0% Debt Market	Portfolio Growth	Rank	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta 25% Debt Cash	Farm Portfolio Beta 25% Debt Market	Portfolio Growth	Rank
Repay Debt	$6,765,134	0	0.017	0.064	43.55%	8	$5,503,712	0	0.017	0.077	45.39%	5
Retain Cash	$6,765,134	0	0.017	0.064	43.55%	9	$5,181,260	0.12	0.018	0.079	33.67%	9
Money Market	$7,049,018	0	0.016	0.063	51.30%	7	$5,326,490	0.12	0.017	0.078	38.95%	8
Mutual Fund	$7,160,746	0	0.016	0.063	54.35%	6	$5,355,094	0.12	0.018	0.079	39.99%	7
Naïve Portfolio	$7,667,642	0	0.016	0.062	68.17%	4	$5,622,110	0.11	0.017	0.078	49.69%	4
Efficient Portfolio	$9,156,337	0	0.013	0.06	108.79%	1	$6,329,170	0.1	0.014	0.075	75.39%	1
Input Stocks	$7,949,917	0	0.014	0.061	75.87%	2	$6,329,170	0.11	0.016	0.077	54.79%	2
Output Stocks	$7,418,552	0	0.016	0.063	61.38%	5	$6,329,170	0.12	0.018	0.078	45.11%	6
Input/Output Stc	$7,682,325	0	0.015	0.062	68.57%	3	$6,329,170	0.11	0.017	0.077	49.91%	3

Table 6. Hidalgo 400-Acre Flood/Sprinkler: Selected Balance Sheet Values

	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta 0% Debt Cash	Farm Portfolio Beta 0% Debt Market	Portfolio Growth	Rank
Repay Debt	$875,432	0	-0.023	0.015	24.01%	7
Retain Cash	$875,432	0	-0.023	0.015	24.01%	8
Money Market	$888,238	0.03	-0.027	0.011	26.26%	6
Mutual Fund	$867,840	0.04	-0.023	0.015	22.67%	9
Naïve Portfolio	$905,660	0.03	-0.024	0.015	29.34%	3
Efficient Portfolio	$953,732	0.02	-0.027	0.012	37.81%	1
Input Stocks	$908,972	0.03	-0.027	0.012	29.92%	2
Output Stocks	$900,649	0.04	-0.023	0.016	28.45%	5
Input/Output Stocks	$904,794	0.03	-0.025	0.014	29.18%	4

the different debt scenarios, and the percentage growth in portfolio value was calculated to exclude the value of land appreciation. Selected values from the 1989 and 2002 balance sheets are reported for each model in Tables 4 through 8.

Investing in the efficient set of stocks dominated all other strategies for all five farm models at every debt load. This strategy resulted in the highest ending value of liquid investments; hence, the highest ending portfolio value and growth rate. Retaining all cash resulted in the smallest ending portfolio value for most models at nearly all debt loads; however, the mutual fund strategy had the worst effect on portfolio value for some scenarios. All other financial strategies were ranked differently depending upon the individual farm model and the initial debt load.

Summary and Conclusions

The objective of this study was to evaluate the possible effects of alternative financial investments for selected New Mexico farms with various production enterprises; specifically, using excess cash generated from each farm for several financial investment strategies and determining each strategy's effect on portfolio value. This study began with the assumption that farmers did not want to sell farm assets and use the proceeds to invest in any particular market. Rather, this study considered the opportunities and possibilities to increase the entire portfolio value (including the farm itself as an asset in the portfolio) by investing excess cash (beyond operating and family living requirements) into different markets or using excess cash to pay down farm debt beyond obligation. This involved developing mixed-asset portfolios by combining agricultural real estate with purely financial assets. Those financial assets included shares of a money market fund, a mutual fund, and several publicly-traded agricultural firms.

Table 7. Quay 600-Acre Sprinkler: Selected Balance Sheet Values

	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta		Portfolio Growth	Rank	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta		Portfolio Growth
	0% Debt						25% Debt				
			Cash	Market					Cash	Market	
Repay Debt	$1,226,324	0	0.062	0.1	102.08%	8	$1,065,899	0	0.071	0.119	126.65%
Retain Cash	$1,226,324	0	0.062	0.1	102.08%	9	$1,003,488	0.08	0.073	0.121	110.68%
Money Market	$1,318,649	0	0.061	0.099	119.92%	7	$1,066,189	0.08	0.07	0.119	126.73%
Mutual Fund	$1,331,710	0	0.056	0.094	122.44%	6	$1,065,239	0.09	0.067	0.115	126.49%
Naïve Portfolio	$1,508,722	0	0.058	0.096	156.64%	4	$1,210,750	0.07	0.068	0.116	163.73%
Efficient Portfolio	$1,937,925	0	0.054	0.091	239.56%	1	$1,496,755	0.05	0.064	0.112	236.93%
Input Stocks	$1,577,987	0	0.056	0.094	170.02%	2	$1,257,569	0.06	0.066	0.115	175.71%
Output Stocks	$1,442,862	0	0.058	0.095	143.92%	5	$1,153,136	0.08	0.069	0.117	148.98%
Input/Output Stocks	$1,508,999	0	0.056	0.094	156.69%	3	$1,212,278	0.07	0.066	0.114	164.12%
	50% Debt						75% Debt				
Repay Debt	$849,649	0	0.083	0.15	153.71%	6	$560,282	0.3	0.102	0.213	177.51%
Retain Cash	$780,469	0.18	0.088	0.155	127.49%	9	$549,171	0.32	0.107	0.217	169.40%
Money Market	$809,916	0.2	0.085	0.152	138.65%	7	$546,603	0.36	0.105	0.216	167.52%
Mutual Fund	$801,668	0.21	0.082	0.15	135.52%	8	$543,442	0.37	0.102	0.213	165.21%
Naïve Portfolio	$890,154	0.18	0.083	0.151	169.06%	3	$571,098	0.36	0.103	0.214	185.41%
Efficient Portfolio	$1,070,452	0.14	0.079	0.146	237.41%	1	$621,442	0.33	0.102	0.212	222.19%
Input Stocks	$922,458	0.17	0.081	0.149	181.31%	2	$582,354	0.35	0.102	0.213	193.64%
Output Stocks	$858,463	0.2	0.084	0.151	157.05%	5	$560,766	0.36	0.103	0.213	177.87%
Input/Output Stocks	$890,114	0.18	0.081	0.149	169.05%	4	$571,534	0.35	0.102	0.213	185.73%

Table 8. Union 1,280-Acre Sprinkler: Selected Balance Sheet Values

	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta		Portfolio Growth	Rank	Ending Owner's Equity	Ending Debt/Asset Ratio	Farm Portfolio Beta		Portfolio Growth	Rank
	0% Debt						25% Debt					
			Cash	Market					Cash	Market		
Repay Debt	$3,973,949	0	0.06	0.096	108.71%	8	$3,468,403	0	0.067	0.113	136.71%	8
Retain Cash	$3,973,949	0	0.06	0.096	108.71%	9	$3,287,960	0.07	0.07	0.117	122.08%	9
Money Market	$4,273,974	0	0.057	0.093	126.99%	7	$3,513,941	0.07	0.067	0.113	140.41%	7
Mutual Fund	$4,371,837	0	0.054	0.09	132.96%	6	$3,553,493	0.07	0.064	0.11	143.61%	6
Naïve Portfolio	$4,926,774	0	0.053	0.089	166.78%	4	$3,974,239	0.06	0.063	0.197	177.74%	4
Efficient Portfolio	$6,459,179	0	0.047	0.083	260.18%	1	$5,080,644	0.05	0.057	0.103	267.47%	1
Input Stocks	$5,200,630	0	0.051	0.087	183.47%	2	$4,170,419	0.06	0.061	0.107	193.65%	2
Output Stocks	$4,671,292	0	0.054	0.09	151.21%	5	$3,803,674	0.06	0.065	0.111	163.90%	5
Input/Output Stocks	$4,936,246	0	0.051	0.087	167.36%	3	$3,978,829	0.06	0.061	0.108	178.11%	3
	50% Debt						75% Debt					
Repay Debt	$2,844,990	0	0.085	0.149	178.10%	6	$2,047,353	0.1	0.094	0.2	258.57%	5
Retain Cash	$2,601,739	0.17	0.085	0.15	148.63%	9	$1,911,659	0.29	0.103	0.209	226.08%	8
Money Market	$2,747,099	0.16	0.081	0.146	166.24%	7	$1,974,590	0.29	0.098	0.204	241.15%	7
Mutual Fund	$2,734,714	0.16	0.079	0.144	164.74%	8	$1,908,101	0.31	0.101	0.207	225.23%	9
Naïve Portfolio	$3,045,079	0.15	0.079	0.143	202.34%	3	$2,082,159	0.29	0.101	0.208	266.91%	3
Efficient Portfolio	$3,689,208	0.13	0.072	0.137	280.39%	1	$2,336,447	0.25	0.096	0.203	327.79%	1
Input Stocks	$3,133,495	0.14	0.075	0.14	213.06%	2	$2,118,295	0.28	0.097	0.203	275.56%	2
Output Stocks	$2,953,821	0.15	0.081	0.144	191.29%	5	$2,043,360	0.29	0.103	0.209	257.62%	6
Input/Output Stocks	$3,042,517	0.15	0.077	0.141	202.03%	4	$2,080,390	0.29	0.099	0.205	266.48%	4

Five of the ten selected farm models could not cash flow at any debt level over the entire period of the analysis without outside income. Therefore, these farms could not carry any debt or consider alternative financial investments. The largest liability for any farmer is the principal on the land purchase. Since land is an appreciating asset, it can be sold for more that what it was purchased for. Accordingly, the appreciating nature of land is valued into its price, and it is not surprising that these farms could not cash flow since the rate of return earned on the farm assets was less than the cost of capital to purchase them. Oltmans (1995) concludes that farmland will not and should not pay for itself if priced correctly in a competitive market and says "the inability of farmland to generate sufficient cash flow to fully service the cost of capital investment required for its purchase is the normal competitive situation." Two of the farm models that could not cash flow, and therefore sustain any debt, could have carried some debt if $25,000 of non-farm annual income was available. Although our approach can easily accommodate off-farm income, it was not a variable in this analysis.

For those five farm models that could cash flow, the different financial strategies considered in this study had various effects on portfolio value depending upon the individual farm model and the initial level of debt. In every case for each farm model, investing in the efficient set of stocks had the greatest effect on portfolio value. This is not surprising since Modern Portfolio Theory says that the efficient set is the optimal set for a given level of risk and return. Retaining all cash resulted in the lowest ending portfolio value for each farm model at almost every debt load, although investing in the mutual fund resulted in the lowest portfolio value for some models. The strategy of repaying debt beyond annual obligation had a better effect on increasing portfolio value as the debt load increased. Paying down debt resulted in the lowest ending debt-to-asset ratio for each farm model at all debt levels. This suggests that farmers could benefit (increase owner's equity) from investing in financial assets and/or paying down their debt liability.

Although farmers may increase their portfolio value by investing in financial assets, there is no evidence to suggest that investing in agricultural companies provides credible diversification benefits to farmers. The very low correlation coefficients between the farm portfolios and the market proxy (S&P 500) lead to extremely small beta coefficients. Almost every calculated beta coefficient (cash or market) was virtually zero or very close to zero. With such small beta coefficients, it is impossible to establish the systematic and unsystematic components of risk, and suggests that there was no clear relationship between the farm portfolio returns and the market returns.

End notes

[1] Any broad market index could be used. We chose the S&P 500, as do most financial modelers, because of its accessibility and wide acceptance and because it captures the vast majority of publicly traded stocks.

[2] Beta is a measure of the riskiness of an asset's returns and is derived from the standard deviations of an asset's returns, the standard deviation of the market's return, and the correlation between the two. It is an integral component of modern portfolio management theory. By definition, the beta of the market as a whole is 1.00; assets with beta >1 are riskier than the market, whereas assets with beta<1 are less risky.

References

Brigham, Eugene F., and Ehrhardt, Michael C. (2002). Financial Management: Theory and Practice, Tenth Edition, Thompson Learning, Inc., 2002.

Hawkes, Jerry M., and Libbin, James D. (2000). Crop Cost and Return Estimates in New Mexico, 1998. Agricultural Experiment Station Research Report, New Mexico State University, Las Cruces, New Mexico.

Lattz, Dale H., Raab, Dwight E., and Cagley, Charles E. (2002). Farm Income and Production Costs for 2001: Advance Report, University of Illinois Extension, College of Agricultural, Consumer and Environmental Sciences, AE-4566.

Libbin, James D., Kohler, Jeremy, and Hawkes, Jerry M. (2004). Does Modern Portfolio Theory Apply To Agricultural Land Ownership? Concepts For Farmers And Farm Managers, *Journal of the American Society of Farm Managers and Rural Appraisers.*

Markowitz, Harry M. (1959). *Portfolio Selection: Efficient Diversification of Investments*, Yale University Press, 1959.

Oltmans, Arnold W. (1995). Why Farmland Cannot, Will Not and Should Not Pay for Itself, *Journal of the American Society of Farm Managers and Rural Appraisers*, 59(1), 57-67.

Value Line Investment Survey. (1989-2002). (various issues)