Investment in Publicly Traded Firms as a Vertical Integration and a Risk Diversification Strategy

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Abstract

This research investigates the potential of investments in publicly traded value adding firms in the meat industry as a strategy for livestock producers to diversify risk and capture value-added profits, while allowing the producer to maintain management authority and minimize costs. The research determines the optimal portfolio of investments in up to 66 publicly traded value-added companies. The results indicate tat a portfolio consisting of livestock production and publicly traded value-added companies provides better returns at a lower risk than either a 100 percent investment in livestock production or a combination of livestock production and the S&P 500.

Introduction

There is great interest among livestock producers to find ways to can reduce risk in their operation and simultaneously capture more of the downstream profits through value-added activities such as cooperatives, investing in production facilities, and/or contractual agreements with existing production facilities. These value-added activities take the form of both partial and full vertical integration and allow the ownership of the livestock product by the producer beyond the farm gate. However, these activities present several challenges to producers. Often, livestock producers find it difficult to obtain the necessary resources to invest in value-adding livestock processing facilities. Contracts are popular for allowing producers to participate in the value chain but they bind producers to sell their livestock to a particular processor, thereby relinquishing the producer's option to look elsewhere for higher prices. Cooperatives are another value-added investment option but they tend to shift management decisions away from the producer to the cooperative and investments tend to be illiquid. As an alternative, investing in the stock market may be advantageous because it does not require the hiring of new employees, management, the purchase of new facilities or equipment, the development of new products (product differentiation), and/or the acquisition of new customers.

Stock markets provide livestock producers the opportunity to purchase stock in companies that have significant value-adding operations beyond the farm. The purchase of stock in these companies allows the livestock producer to maintain a level of retained ownership in their livestock product as it moves through the processing channel. Since stockholders own a share of the companies, and the products they produce, investing in one or more of these publicly traded company might be a suitable technique to capture value-added profits.

Investing vertically through the stock market allows livestock producers to buy a level of risk-management unavailable through vertical integration. With traditional vertical integration, the risk is associated with the single, value-added, investment and the current livestock enterprise, with no ability to diversify away the risk through multiple investments. Investing in publicly traded value-added livestock processing companies via the stock market may serve as hedge to defend against the risk associated with livestock enterprise investments.

The primary objective of this research is to investigate the potential of a value-added portfolio consisting of investments in livestock production and publicly traded value-adding processing companies that will reduce risk and improve annual returns relative to investing strictly in livestock production. This portfolio of value-added investments will be examined for both yearling feeder cattle and pork finishing enterprises. The goal is to provide producers with information on using investments in publicly traded companies as an alternative to direct investment in physical assets for capturing the benefits of value-added activities.

Literature Review

Current value-added investments that are being utilized by livestock producers are activities such as cooperatives, investment in processing facilities, contracts, and hedging. Sporleder (1992), Royer (1995a) Torgerson (2000), Harris and Fulton (1996), and Hampel et al. (1996) have written several articles on these topics.

Cooperatives have a very difficult time in raising the necessary equity for vertical expansion because of their organizational structure. Cooperatives often must rely on external debt financing, so cooperatives generally avoid any investments that are deemed relatively risky. This is done because patrons of the cooperative have a large amount of their off-farm capital invested in the cooperative, and it is because of the unknown risk associated with further vertical integration (Royer, 1995a).

Seibert et al. (1997) indicate that a unique opportunity exists for farmers to increase post-harvest profit by incorporating value-added investments into their operations in the form of investing in publicly traded stocks of agribusiness firms. Benefits of this investment include not having to hire new employees or management, the purchase of new facilities or equipment is not needed, the agriculture producer does not have to rely on the development of new products (product differentiation), and the acquisition of a new customer base is not required. The research conducted in the paper expands Seibert et al's. research by developing a portfolio of these value-added stocks.

For all given levels of expected revenue, there is a portfolio of stocks that can minimize the variance of an expected level of return, and these points can be mapped into an efficient frontier of investments (Markowitz, 1952). The separation theorem developed by Tobin (1958) utilizes the mean variance framework developed by Markowitz, to reach the conclusion that all investors will have the same proportionate composition of stocks in their portfolio regardless of the utility function. This idea was further enhanced through the development of the Shape Ratio (Sharpe, 1966), which determines the optimal portfolio for any risk averse investor, with the following equation

1. $$\text{Sharpe Ratio} = \frac{\text{Portfolio Return} - \text{Risk Free Rate}^{*}}{\text{Standard Deviation of The Portfolio}},$$

and uses financing (borrowing and lending) to allow for different levels of risk aversion.

Methodology

The simulation model used in this study develops portfolios for livestock producers that contain investments in value added stocks and the livestock enterprises by maximizing the Sharpe Ratio. All stock

returns are included in the simulation model, although, not all of the stocks are utilized by each livestock producer in their respective enterprise. The simulation model was developed in Excel 2000 with the Solver and @Risk Add-ins. The model was solved for producers in yearling cattle feeding operations and feeder pig operations under restrictions that they must be invested in the livestock enterprise. Each livestock species model was then solved with no restrictions on the minimum investment in the livestock enterprise. This methodology allows for a comparison of the gains and risk reduction from using the stock market as a value-added investment strategy relative to 100 percent investment in a livestock enterprise. The remainder of this section outlines the methodology-detail.

The Sharpe Ratio

The efficient portfolio for the livestock producer occurs at the maximum point of tangency between the Markowitz efficient frontier and the straight line that emanates from the risk free investment outward. This point of tangency occurs when the slope of the following equation is maximized:

2. $$\text{Sharpe Ratio (Index)} = \frac{E_p - E_0}{\sigma_p},$$

where E_p is the expected return to the portfolio, E_0 is the expected return to the risk free asset, and σ_p is the standard deviation of the expected return of the livestock producer's portfolio (Sharpe, 1966). The inclusion of the risk free investment, cash in this model, allows the livestock producers the opportunity to incorporate borrowing and lending strategies into their overall investment strategy. Borrowing and lending transforms the efficient frontier into a straight line. Now the livestock producer only needs to decide how much to lend or borrow. No other available combinations of assets that lie on the Markowitz efficient frontier are as efficient as the combination of assets at the maximum point of tangency between the straight line created by the addition of the risk free investment and the efficient frontier. This point of tangency is shown as point X in Tangency of Borrow/Lend Line and the Markowitz Efficient Frontier. The decision to purchase a portfolio that has a combination of assets represented by point X is the investment decision.

The decision to sell a riskless asset is indicative of lending, while borrowing represents leveraging a portfolio. These decisions rely on the risk aversion level of the livestock producer and makeup the financing

decision (Sharpe, 1970). The investment and finance decisions give rise to the Separation Theorem. The Separation Theorem suggests that all investors regardless of their level of risk aversion should hold the same combination of stocks as indicated by the tangency point X. Thus, the Sharpe ratio is able to typify the risk and return of the portfolio in a solitary measure that categorizes the performance of the livestock producer's portfolio on a risk-adjusted basis. The larger the slope of the line the better the portfolio has performed. The focus of this research is to determine the investment portfolio of livestock production and value-added companies that provide the highest Sharpe Ratio

Scenarios

The invest model incorporates scenarios to examine the impacts of varying levels of minimum investment in the livestock enterprise on the optimal value-added portfolio. Table 1. Scenario Descriptions has the different scenarios and the percentage invested in the livestock enterprise, the securities, and the S & P 500.

Each livestock enterprise uses the three scenarios in the Table 1. Thus, each of the scenarios provides a different investment strategy for the livestock producer based on the given level of investment in the livestock enterprise and the stock selections. The consequences for limiting the proportion of the investment in livestock enterprise will be examined. Each of the investment strategies base on historical returns data for the livestock enterprises and value-adding companies over the 1974-2001 period. Only the value-adding companies that had stock return data available for the entire time period were used in the development of the portfolio.

Data

Two livestock enterprises were chosen for the study: finishing choice yearling steers to choice slaughter grade and finishing feeder pigs. The model used in the study requires return data for each of these enterprises as well as stock and dividend prices for the value added agribusiness firms and the return data for the S&P 500.

Classification of Agribusiness Firms

The 14 agricultural business firms used in the development of the portfolio in this study belonged to the following NAICS and/or SIC classes as defined by the U.S. Department of Commerce Economics and Statistics Administration Bureau of the Census: Industry 2011, Meat Packing Plants; Industry 2013, Sausages and Other Prepared Meats; 2077 Animal and Marine Fats and Oils; 311611 Animal (except Poultry) Slaughtering; 311612 Meat Processed from Carcasses; and 311613 Rendering and Meat Byproduct Processing. These respective codes correspond to industries that are first handlers of livestock products beyond the farm gate; they are the next step in the value-added chain. Note that many of these companies have operations beyond the first handler processing level of the livestock products.

Each of the companies used in this study are publicly traded on one of the following exchanges: New York Stock Exchange (NYSE), Nasdaq formerly National Association of Securities Dealers Automated Quotations (NASDAQ), American Stock Exchange (AMEX formerly ASE), and Over the Counter (OTH). Each company is also an American based firm. Daily stock and dividend prices from January 2, 1973 to December 31, 2001 were obtained from the Center for Research in Security Prices (CRSP) dataset accessed through the Wharton Research Data Services (WRDS) database.

Return Measures

The daily stock price given by the CRSP dataset is the closing price or the negative bid/ask average (if a closing price is not available on that trading day). If the company trades on more than one exchange, the trade, which occurs last, no matter the exchange, is the closing price that is used. The dividend amount used is the U.S. dollar value per share of distributions resulting from cash dividends, spin-offs, mergers, exchanges, reorganizations, liquidations, and rights issues as defined by the CRSP. The daily stock rate of return for the S&P 500 and for each of the agribusiness firms was calculated as the change in stock price between consecutive time periods plus dividends (if the company paid dividends). The equation is as follows:

3. $$k_{i,t} = \frac{(P_{i,t+1} - P_{i,t} + D_{i,t})}{P_{i,t}} \quad ,$$

where $k_{i,t}$ is the percentage return to an investor in agribusiness firm i, $P_{i,t}$ is the price per share of firm i's stock in period t, and $D_{i,t}$ is the dividend per share of the agribusiness firm i's stock in period t. CRSP classifies this as the Holding Period Return, and it is defined as the change in total value of an investment in common stock over a period of time per initial dollar investment. Because livestock production return data could only be obtained on a monthly basis, daily rates of return for the stock were compounded into monthly returns by the following equation:

4. $$r_{i,t} = \prod_{j=1}^{n} (1 + k_{i,t}) - 1 \ ,$$

where $r_{i,t}$ is the compound monthly return to the livestock producer in firm i in month t, $k_{i,t}$ is the daily rate of return, and n represents the number of trading days during month t.

These monthly returns were compounded into an investment period return for each of the livestock enterprises with the subsequent equation:

5. $$R_{i,m,e} = \prod_{j=1}^{l} (r_{i,t,e}) - 1 ,$$

where $R_{i,m,e}$ is the compounded period investment return to the livestock producer in agribusiness firm i in period m for livestock species e, l represents holding period for the investment. This equation allows for the investment period in of the agribusiness stocks to mirror the investment period of the respective livestock enterprises. For the yearling cattle enterprise the investment period was assumed to be months and for the hog finishing operation the investment period is assumed to be months.

The annual return for the securities, the S&P 500, and the livestock enterprise are determined as:

6. $$a_i = \frac{\sum r_{i,e,m}}{12} ,$$

Stochastic Model

The historical annualized returns developed above are used to develop a stochastic sample of each of the investment choices returns. To maintain the historical covariance between the investment options, a non-

parametric bootstrapping simulation was employed. The simulation was designed to randomly select one of the 27 years of annual returns for all investment options simultaneously. By randomly selecting the returns data for all investments in the same period the historical covariance among the returns is assured to be maintained. The simulation model was ran for 1000 iterations to develop a matrix of stochastic investment option returns for both yearling cattle and hog finishing enterprises. The matrix of returns data for all investment options is used in conjunction with the Sharpe ratio to develop the optimal portfolio. A vector of stochastic returns for the portfolio is developed with the following equation:

7. $$P_{z,e}(a,w) = \sum_i a_{i,z,e} w_{i,e} ,$$

where P_z is the portfolio return for iteration z gives the returns for agribusiness, *i* in iteration *z*, and the investment weight w_i, for each agribusiness, *i* in the portfolio. The mean and standard deviation of the vector of portfolio returns is then used to compute the Sharpe Ratio. Choosing the weights for each investment option maximizes the Sharpe Ratio. Equation 8 summarizes this calculation:

8. $$\underset{w_i}{Max}\, S = \frac{\frac{\sum P_{z,e}(a,w)}{1000}}{\sqrt{\frac{\sum (P_{z,e}(a,w) - \bar{P_e}(a,w))^2}{1000}}}$$
$$S.t \sum_{0<w_j}^{w_j=1}$$

Equation 8 is subject to a non negativity constraint on the weights. In addition the model is constrained such that the sum of the weights for each company *i* is equal to 1, preventing short selling or borrowing. Finally, depending on the scenario being analyzed, equation 8 will be constrained to place a minimum amount of the portfolio investment in the particular livestock enterprise. For example, the second scenario restricts the portfolio to have a minimum of 70 percent of the portfolio in the yearling, cattle enterprise. The same constraint would exist for the hog-finishing portfolio

Empirical Results

The inclusion of the value-added securities as possible investment alternatives for the livestock producer accomplishes the goals of risk diversification and value-added through vertical integration via shareholder ownership in value-adding companies. Table 3 presents the results for the value-added investment portfolios for yearling cattle enterprises estimated with the simulation models. Table 3 shows the results for three scenarios for a cattle producer: 1) investment only in the cattle operation (100% investment); 2) investment of a minimum of 70% of the portfolio in the yearling enterprise and the remaining 30% in the model-selected stocks; and 3) no pre-determined minimum investment requirement in the yearling operation, i.e, the model freely chooses the investments and their associated percentages. Results of the three scenarios indicate that the mean return, standard deviation, and the Sharpe Ratio improved as the restriction placed on the percentage investment in the livestock enterprise was relaxed. A producer who is not interested in value-added investment, and thus invests only in the yearling enterprise, has a mean return of 1.6% and standard deviation of 3.2%. An individual willing to invest a maximum of 30% of a portfolio in value-adding companies has an improved mean return of 2.5% and less risk (as measured by the standard deviation of 2.4%). Results for this investment scenario indicate the portfolio is optimized when the minimum required amount of 70% is invested in the yearling enterprise and the remaining 30% is split between just two stocks: Bob Evans at roughly 9% and Tyson at roughly 21%. The S&P investment variable was not selected by Solver in any of the portfolios regardless of the scenario, indicating that it is not a viable portfolio investment selection for yearling cattle producers.

Investment into the value-added stocks by the hog-finishing producer seems to be an effective method of diversification and vertical integration into the food-marketing channel. Table 4 show the portfolio model results for hog-finishing producers and is laid out in the same format as the Table 3. As with yearling livestock, if the livestock producer is willing to reduce the amount of investment required in the hog-finishing operation, he/she will be able to see an increase in his/her annual return as well as a reduction in the risk of their portfolio. The Sharpe Ratio increased, whenever the percentage required to be invested in the

livestock enterprise declined. Thus, a value-added portfolio, accomplishes the task of adding return to a hog-finishing operation, while also diversifying the risk associated with only an investment in a hog finishing enterprise.

The aforementioned results suggest that the weight constraints placed upon the amount of investment required in the hog finishing enterprise as a part of the livestock producer's portfolio are binding, and that if possible, the hog producer would like to further invest into value added stocks. If a minimum investment of 70% were required in the hog-finishing operation, the hog producer would place the remaining 30 % of the investment in Bob Evans. Thus, Bob Evans value added stock, comprises the remainder of the portfolio, needed to achieve optimization. In the scenario when the optimization software is not restricted by any required livestock investment amounts, investments are made in nine of the value-added securities and also in the hog-finishing enterprise. At 2.74% of the total investment the hog finishing enterprise no longer becomes a binding constraint. These results might suggest that it may be possible for those livestock producer's who operate small hog operations, to obtain a well-diversified portfolio through the inclusion of valued added securities in their portfolios. Again, as with the yearling cattle operation, the S&P 500 was never selected as part of the optimal portfolio.

Implementations

There are numerous financial and analytical tools available for livestock producers to develop comprehensive financial investment portfolios that helps them diversify away the risk associated with their livestock enterprise and capture value-added benefits. There are many financial programs, software, databases, and online information available to any individual for purchase. Most anyone who has access to a computer and/or to the Internet can gain access to many of these services. These tools are generally easily understood and do not require a previous background in financial management.

If livestock producers are unsure if they can devote the required amount of time and effort into understanding and maintaining a portfolio that accomplishes their goals and disseminates all information available to them, other options are available. Livestock producers could develop their value-added risk-

diversifying portfolios through the assistance of a financial advisor. A financial advisor will have the ability to analyze a livestock producer's needs and current financial situation in order to make individualized recommendations.

This ease of access to information and to making transactions in the stock market provides livestock producers with freedom that is not available with other current risk diversification and value-added strategies. However, there are fees and transaction costs associated with investment in the various securities markets that are not included in this study. These costs and need to be carefully evaluated by the livestock producer when determining the proper course for the management of his/her portfolio. For instance, the more the livestock producer relies on a financial planner to develop his or her portfolio, then the more it will cost the livestock producer to develop this portfolio. Additionally, since the Internet contains vast amounts of unrestricted investment information, it is wise to check the validity of any source to verify its credibility before subscribing to an investment newsletter or working with an online brokerage company.

Summary

In recent years, there has been a growing urgency among livestock producers to substantially reduce the risk associated with their livestock enterprises and capture some of the profit associated with value-added activities. The livestock market has seen a change in recent years, as consumers are no longer content with a homogenous bulk product, instead they want a product that has value added to it, such as lean meat. Changes such as these have challenged livestock producers to find ways to capitalize on the demand for these value-added products. However, many of the traditional methods used to create value have either been financially infeasible and/or simply do not accomplish the goals set forth by the livestock producer. The objective of this research is to show that investment in a portfolio of publicly held companies, that are first handlers of the livestock products turned out by livestock producers, is both a risk diversification and a value-added activity.

In this study, an optimal portfolio that maximizes the Sharpe Ratio was constructed in Excel with Solver and @RISK. Using stochastic simulation, a value-added and risk-diversifying portfolio for livestock producers was created. Constructing a portfolio containing publicly held companies that are first handlers of

the livestock products, allows livestock producers the ability to diversify and integrate in a manner different than their traditional value-added and risk diversification strategies.

The extent of diversification of the portfolio for the livestock producer depends on the correlation between the stocks and the livestock enterprise. The more the returns are inversely related to the livestock enterprise, the greater the diversification in the portfolio given the intercorrelation between the securities. The diversification of the portfolio in this study depends on the premise that the stocks of publicly held companies are negatively correlated and/or are relatively uncorrelated to the returns to the livestock enterprise. Thus, securities are used in the portfolio to minimize the ups and downs associated with the returns of the livestock enterprise.

The optimal portfolio for each of the livestock enterprises was evaluated for six time periods with each time period containing fourteen different investment strategies. Each investment strategy required that a certain amount of the portfolio's total weight be invested in the livestock enterprise and the S&P 500.

The results from this study indicate that value added investment in publicly held stocks is a viable risk diversification and vertical integration activity. The model provides evidence that diversification into value-added stocks reduces risk below the level associated faced by a livestock producer who only invests in the livestock enterprise, and at the same time it increases the return to the producer. A value-added risk diversification strategy through the use of these value-added stocks is further supported by the Sharpe Ratios obtained from the optimization models. The values for the Sharpe Ratios increase the restriction on the required on the percentage livestock investment is reduced, suggesting that value added stocks to benefit the livestock producer.

Possible areas of future research include examining multiperiod investment horizons, to assist those livestock producers with long-term investment plans. Another area of possible research is to examine other methods of risk measurement, particularly downside risk. One of the limitations of the model is that transactions costs are not included. Inclusion of these transaction costs may provide a more optimal portfolio because it takes into account all of the costs associated with trading on the market.

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Table 1. Scenario Descriptions

Scenario	Livestock Enterprise	Investment Allocation into securities	S & P 500
9	≥70%	≤30%	
15	=1	=0%	
16	=1, where the livestock enterprise initially is weighted 1		

Table 2. Description of Stocks

NAME	TICKER SYMBOL	STOCK EXCHANGE	SIC	NAICS	DATA RANGE
BOB EVANS FARMS INC	BOBE	NASDAQ		311612	19721214-20011231
BRIDGFORD FOODS CORP	BRID		2013		19721214-20011231
CHIQUITA BRANDS INTL INC, UNITED BRANDS CO, AND UNITED FRUIT CO	CQB,UB, AND UF	NYSE		311612	19620702-20011231
CONAGRA INC	CAG	NYSE		311611	19721214-20011231
FLEMING COMPANIES INC	FLM	NYSE	2011		19681206-20011231
GENERAL MILLS INC	GIS	NYSE	2011		19620702-20011231
HEINZ H J CO	HNZ	NYSE	2011		19620702-20011231
HORMEL FOODS CORP	HRL	NYSE		311611	19620702-20011231
PHILIP MORRIS INC	MO	NYSE	2111		19620702-20011231
RALSTON PURINA CO	RAL	NYSE	2011		19620702-20011231
SARA LEE CORP AND CONSOLIDATED FOODS CORP	SLE AND CFD	NYSE	2013	311612	19620702-20011231
SEABOARD CORP	SEB	AMEX		311611	19620702-20011231
SMITHFIELD FOODS INC	SFD	NYSE	2013		19721214-20011231
TYSON FOODS INC	TSN	NASDAQ	2013		19721214-20011231
S & P 500					19721214-20011231
YEARLING CATTLE					19721214-20011231
FINISHING HOGS					19721214-20011231

Table 3. Value-Added Investment Portfolio Results for Yearling Cattle Enterprises

	Restriction on Investment Percentage in Yearlings		
	100%	70%	No Restriction
	Portfolio Allocations		
Bob Evans	0.00%	8.79%	11.03%
Bridgeford Foods	0.00%	0.00%	6.84%
Chiquita Brands	0.00%	0.00%	8.90%
Sara Lee	0.00%	0.00%	6.38%
Fleming Foods	0.00%	0.00%	11.00%
General Mills	0.00%	0.00%	23.04%
Hormel Foods	0.00%	0.00%	14.90%
Ralston Purina	0.00%	0.00%	4.68%
Tyson	0.00%	21.21%	5.53%
S&P 500	0.00%	0.00%	0.00%
Yearling Enterprise	100.00%	70.00%	7.71%
	Portfolio Summary Statistics		
Mean Return	1.61%	2.54%	3.10%
Standard Deviation	3.24%	2.36%	0.94%
Sharpe Ratio	0.4976	1.0758	3.2881

Table 4. Value-Added Investment Portfolio Results for Hog Finishing Enterprises

	Restriction on Investment Percentage in Finishing Hogs		
	100%	70%	No Restriction
	Portfolio Allocations		
Bob Evans	0.00%	30.00%	14.59%
Bridgeford Foods	0.00%	0.00%	9.96%
Chiquita Brands	0.00%	0.00%	7.25%
Sara Lee	0.00%	0.00%	12.16%
Fleming Foods	0.00%	0.00%	6.09%
General Mills	0.00%	0.00%	25.19%
Hormel Foods	0.00%	0.00%	10.78%
Ralston Purina	0.00%	0.00%	2.01%
Tyson	0.00%	0.00%	9.23%
S&P 500	0.00%	0.00%	0.00%
Finishing Enterprise	100.00%	70.00%	2.74%
	Portfolio Summary Statistics		
Mean Return	1.66%	2.16%	2.46%
Standard Deviation	4.42%	3.13%	0.85%
Sharpe Ratio	0.3755	0.6894	2.8909

Figure 1. Tangency of Borrow/Lend Line and the Markowitz Efficient Frontier