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Factors Influencing Value of Agribusiness Firms Marketing Animal Proteins

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Abstract

In today's globalized world, some agribusinesses are diversifying to other agricultural and non-agricultural products to combat the inherent risks associated with marketing agricultural goods, while others have intensified in one particular area. For example, Tyson Foods, Incorporated, one of the largest publicly-traded and globally recognized agribusinesses, began making poultry products in the 1930s and has since diversified to market beef, pork, and other food products through either acquisitions or expansion of core business strategy, while Cal-Maine Foods has continued to stay true to its core business of egg production and marketing. A diversified portfolio is expected to alleviate the effects of business disrupting events such as product recalls, droughts, or animal disease events. Protein companies specifically face risks associated with feed sourcing, animal health and welfare, and food safety. The aim of this work is to analyze the value of product diversification on an agribusiness' worth using stock prices to value each of the top 100 meat companies that are publically traded in the United States. Daily stock prices from 2007-2016 have been collected and are used to identify the factors that contribute to the value of a company, while accounting for the heterogeneity of agribusiness management and strategy.

Key words: hedonic pricing, stock diversification, animal protien

INTRODUCTION

Agribusiness and allied industries are in a unique position to face risks in operation not faced by nonagricultural businesses. These industries are affected by market forces as well as natural disasters, weather phenomenon, animal and plant health related events, food safety concerns, consumer perceptions, among many other factors not listed. In order to combat these risks, some agribusinesses have diversified their business portfolios to maintain revenue streams during such an event. Other companies have chosen to intensify development of a single industry, capitalizing market shares. This heterogeneity of management decisions lead to varied outcomes, but raises the question whether there is value in diversification, and if so, what are the factors contributing to their success.

Agribusinesses do not provide income and revenue statements freely to maintain confidentiality and trade secrets. However, those agribusiness that publically trade must annually report financial statements and the value of the company is recorded daily in terms of stock prices. These prices have been shown to be a proxy for company value as they immediately reflect changes in the cost of business, the effects of a related event, and market fluctuations (Pozo and Schroeder 2015). While not perfect information, the daily stock prices and related company profiles can provide detailed and relevant information to help understand the factors contributing to the value of an agribusiness.

The goal of this work is to analyze the value of product diversification on an agribusiness' worth using stock prices to value the top 100 meat companies that are publically traded in the United States using daily stock prices from 2007-2016. Meat companies provide heterogeneous factors, considering which protein a company will produce, process, or market. Accounting for the heterogeneity of agribusiness management and strategy, the decomposition of

stock prices will provide agribusiness managers information when determining strategic short- and long-term business strategies.

PREVIOUS LITERATURE

Stock prices have been used in various ways to estimate firm value, the effects on firms related to market disruptions, or estimate longevity of an industry. Pendell and Cho (2013) evaluated Korean stock market reactions after several foot-and-mouth disease (FMD) outbreaks. They compared daily stock values of agricultural and allied businesses to analyze how stock prices faired for those companies before and after the FMD events finding that the effects of FMD were gradually realized in the market rather than instantaneous and that agricultural sectors were affected heterogeneously (Pendell and Cho 2013). Their analysis implies market volatility during a disease event is a function of the marketing composition of the firm.

Pozo and Schroeder (2015) estimated the effects on stock prices revolving around meat and poultry meat recalls in the United States. The effects of a recall affect a firm's value and considering a firm's stock price is expected to mirror a firm's value. The volatility in stock values reflects the volatility in that particular businesses' value during a food recall event. They estimated the effects of these events using an event study approach while including additional factors that could contribute to the volatility or lack thereof. One of their factors was firm diversification, which are thought to decrease the volatility to the studied event as diversification might mitigate some of the negative effects of a market disruptive event. However, regardless of firm size, their results show a firm's value begins to decrease when food safety and human health become a concern (Pozo and Schroeder 2015).

This study uses similar data to Pozo and Schroeder to consider the diversification factors and how they contribute to price realization. The factors considered are similar to the previous

studies, focusing on the types of animal proteins and company characteristics. Knowing the value of firm attributes can provide valuable insights into management decisions. This also can contribute to understanding of how a firm might manage a sector disrupting event such as a disease outbreak or food recall.

METHODOLOGY

To study the factors contributing to firm value, including diversification, a hedonic pricing model is estimated. Hedonic pricing is a well-known estimation method used in decomposing the value of a good or service into its individual characteristics or attributes. The link between prices and product quality was presented by Waugh (1928) and incorporated into consumer demand literature by Lancaster (1971). Theoretical foundations for hedonic modeling were provided by Rosen (1974) and Lucas (1975). Hedonic modeling estimates the implicit value of a good's attribute which provides underlying utility to the consumer. In this study, the value of a publically traded agribusiness is implicitly comprised of attributes of the firm, the products and proteins marketed by the firm, and market factors. Decomposing the price of a firm into the sum of the value of its attributes across business provides a way to estimate the value of those attributes (O'Donoghue et al. 2015). Because each characteristic is implied to be of some value to the company, it can also be assumed that each factor contributes some amount of utility to the company (Hagerman et al. 2017).

Using motivation from Pozo and Schroeder (2015), average daily stock prices will be used as a proxy for firm value. Average daily stock prices reflect the average price traded on a given trading day weighted by the volume traded and the price paid. The empirical model uses these stock prices as the dependent variables and the attributes as regressors (Equation 1). Stock price in this hedonic pricing case, is the estimated value of an agribusiness.

(1) $$stockprice_{i,t^d} = \beta_1 + \beta_2 beef + \beta_3 pork + \beta_4 chicken + \beta_5 turkey + \beta_6 egg + \beta_7 other + \beta_8 nonfood + \beta_9 multicommodity + \beta_{10} subsidary + \beta_{11} parent + \beta_{12} assets_{t^a} + \beta_{13} employees_{t^a} + \beta_{14} experience_{t^a} + \beta_{15} SP500_{t^d} + \beta_{16} SP500_{t-1^d} + \varphi time + \varepsilon_{i,t^d}$$

where:

stockprice = average stock price for company *i* in time *t* on a daily basis (*d*)

beef, pork, chicken, turkey, egg = 1, if that company markets the protein; 0 otherwise

other = 1, if a company sells other food different than the specified proteins; 0 otherwise

nonfood = 1, if the company sells non-food items; 0 otherwise

multicommodity = 1, if the company sells more than one of beef, pork, chicken, or turkey; 0 otherwise

subsidiary = 1, if the company is a subsidiary company; 0 otherwise

parent = 1, if the company is the parent company; 0 otherwise

assets = the company's total assets in time *t* on an annual basis (*a*)

employees = the total number of employees in time *t* on an annual basis

experience = the total years of operation for a company in time *t* on an annual basis

SP500 = the daily stock market index for the Standards and Poor's top 500 companies for time *t* and lagged once for time *t-1*

time = matrix of year and month binary variables

ε = the error term

β_i = estimated coefficients for respective variables

φ = vector of coefficients on time variables.

The empirical model will be estimated with ordinary least squares (OLS). This is consistent with hedonic pricing models in the literature (Rosen, 1974; Yen et al., 2014). To test for heteroskedasticity, a Breusch-Pagan/ Cook-Weisberg test will be conducted to test for constant variance of the fitted variables. If heteroskedasticity is present, robust standard errors can be used to correct for the inconsistent variances and correct the inflated standard errors.

DATA

Daily average stock prices were collected from the Wharton Research Data Services database (WRDS, 2017) for the top 100 meat companies in the United States that were publically traded from 2007-2016. Using publically available company data, we also recorded which food products each company marketed and whether or not that company was a parent company, stand alone, or a subsidiary. From the public list, several companies were dropped from the data set due to incomplete prices for the targeted study period creating data inconsistencies, lack of publicly available information, or because a company was bought, merged, or sold during the specified time period to a non-publically traded company.

The full list of companies included in the analysis include 13 companies (Table 1): Alico, Inc., Bob Evans Farms, Inc., Cal-Maine Foods, Inc., Conagra Brands Inc., Hormel Foods Corporation, Industrias Bachoco S.A.B. de C.V., Kraft Heinz Co., Leucadia National Corporation, Pilgrim's Pride Corporation, Sanderson's Farms, Inc., Sysco Corporation, and Tyson Foods, Inc. Seaboard Corporation is a primary seafood company and the only company in the data set that sells seafood. Due to the average stock price for Seaboard being significantly higher than the other included companies and its status as the only seafood company, it was dropped from the analysis. Several of these companies changed or operated under different names over the ten-year study period, but their affiliations were recorded under their 2016

trading firm. The exceptions were Industrias Bachoco S.A.B. de C.V. and Kraft Heinz, Co. Industrias Bachoco acquired the American company OK Foods, Inc. in 2011 at which time it began publicly trading. Similarly, Kraft Foods, the predecessor to Kraft Heinz Co., was established in 2012. Due to these companies playing major components in the U.S. animal protein industry today, they were retained in the data set, but only include the available data.

Additional, dichotomous variables were included in the dataset from each company's annual reports using the reports from the study period. Information that was available and common across the companies were the company's number of employees per year, years of operation, and total assets per year. Each of these could play a significant role when determining the value of a company. The number of employees speak to the size of the company over time. The years of operation express the institutional knowledge and experiential learning that comes with business longevity. Total asset may indicate access to capital and ability to financially withstand a market disruption.

The product marketing categories included in the analysis are beef, pork, chicken, turkey, eggs, other food, and nonfood (Table 2). Lamb was excluded as an animal protein variable in the data set as there were no reported accounts of the companies included in this analysis marketing lamb. A binary variable was included to account for a business marketing multiple commodities to capture the compounded results of multi-protein businesses. Other food and non-food variables capture diversification outside of animal protein and outside of food, which may show an ability to diversify operational risks.

The Standard & Poor's 500 market index was included to account for changes in stock prices due to market movements. A lagged index was also included to account for endogeneity of the market index and these large meat companies. Time dummy variables were included to

account for time specific market effects such as the great recession, cyclical market structures, and cattle cycles.

RESULTS AND DISCUSSION

To check for multicollinearity, a correlation matrix of the variables was created (Table 3). All values are less than 0.8, so the assumption was made that no perfect collinearity exists within the model. No perfect or near perfect multicollinearity were evident.

After plotting the residuals in the model, there was visual evidence that some heteroskedasticity was present. This was followed by the Breusch-Pagan/ Cook-Weisberg test for heteroskedasticity, which statistically confirmed the presence of heteroskedasticity in the data. To correct for heteroskedasticity, the regression was re-estimated with robust standard errors.

Model Fit

The overall fit of regression for this model was suitable. Because the regression ran with robust standard errors it does not report an F-statistic. The R^2 of the regression was 0.6902, meaning the variables in the model explain 69.02% of the variation in stock price (Table 4). The regression is said to be fit for the model.

Regression Results

The animal protein variables of interest in this model are: beef, pork, chicken, turkey, eggs, and multi-commodity (Table IV). Agribusinesses marketing beef do not have a significantly different price than those not marketing beef. This could be due in part to many of the companies marketing multiple commodities which will be discussed later. Very few publically traded meat companies market only beef. The list includes Alico Incorporated and Leucadia National.

Poultry commodities all had a significant and positive effect on stock price. Turkey had the largest effect with an increase in stock price by $53.12. Chicken increased stock prices by

$17.55 and eggs affected stock prices by $29.59. Each of these are significant at the 0.01 level. While many companies sell multiple commodities, poultry appears to be profitable enterprise.

Pork is the only commodity to have a significant negative effect on stock price. If a company markets pork products, it has on average a $27.25 lower stock price than those that do not. There were no companies that solely marketed pork products. This implies that those companies selling multiple commodities, pork acts as a potential negative investment. This is consistent with recent venture by larger, international companies such as JBS or Smithfield, in capturing market shares in the pork sector (Philpott, 2010).

Companies marketing multiple commodities, had a significantly lower stock price ($24.10) than those focusing on a primary commodity. While this can be driven by lower commodity products, this may also be driven by lack of available information and variability across these companies. Companies do not report what revenues stem from individual business lines which limits the ability to fully capture the effects of a specific commodity on stock price. The initial aim was to separate these into specific commodity groupings, but these often left only one company included and were excluded to due multicollinearity.

Companies who sold other products, both food and nonfood, also had a statistically higher stock price on average, which reiterates the benefits of product diversification. Other food added $4.20 to the value of a traded meat company. This diversification by businesses into non-meat foods provides some level of risk aversion. In terms of non-food diversification, this was estimated to provide $14.20 worth of value to a firm's stock price. This is consistent with Pozo and Schroeder (2015) which concluded diversification of firms acted as a means of some risk minimization during a food recall event.

Additional explanatory variables also were estimated. Of these, if a company is a subsidiary company the stock price of that company more than if it were a parent company. The three experiential variables that were added to the original data set –Total Assets, Number of Employees, and Years of Experience– are significant however, minimally so. The only notable one was Years of Experience, but it only increases a company's stock price by $0.08.

These results can be extremely beneficial to an animal protein company who is trying to expand into a different protein or looking to expand their marketing portfolio. Potential investors would find it valuable to know that animal protein companies overall, have a lower stock price in the early, winter months of the year.

They can see on average, that over the past ten years, diversifying into other foods and non-food was estimated to increase a company's value. While there are limitations due to lack of publically available data on protein contribution to the profit lines, this work provides a decomposition of stock prices and the value of marketing lines to agribusinesses.

CONCLUSIONS

This work used a hedonic pricing model to estimate the value of an agribusiness through the daily prices traded on the stock market. The objective was to decompose the stock price into various marketing lines, company characteristics, and market factors to estimate their value. This work shows the value of diversification on firms, though non-food and other, non-protein marketing lines adds positive increases to the company's stock price. This information can be useful to new investors, shareholders, and agribusinesses.

Limitations in available information make it difficult to truly understand the actual value of a specific protein contributes to an agribusiness, but there is some information that can be estimated. The results show that poultry marketing lines have a greater value (stock price) than a

company that does not market poultry. While beef was not statistically significant, these results do not indicate the lack of value for beef, rather that many companies selling beef have multiple proteins being marketed. Additionally, there are seasonal trends in value of a protein company.

In the future, this model can be improved by updating and growing the data set that was used. Variables such as location or average annual salary could be two of a multitude of other variables that could be included as explanatory factors that might increase the explanatory power of the model. However, the goal of this study was to decompose prices. Future work could expand this in comparing non-protein to protein companies to develop a fuller understanding of agricultural businesses.

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Table 1: Summary of Stock Price per Company

Company Name	*Mean*	*Std. Dev.*	*Max*	*Min*	*N*
Alico Incorporated	34.92	9.97	64.85	17.87	2,518
Bob Evans Farms	37.12	9.43	59.64	13.44	2,518
Cal Maine Foods	38.29	14.35	95.96	8.47	2,518
Conagra	28.90	8.11	48.68	13.80	2,518
Hormel Foods	40.39	10.46	82.86	25.01	2,518
Industrias Bacho	39.53	13.49	63.49	17.40	1,510
Kraft	65.54	14.23	89.97	43.77	1,079
Leucadia National	27.13	8.71	56.33	10.85	2,518
Pilgrim's Pride	17.14	10.13	40.59	0.25	2,248
Sanderson Farms	56.67	19.73	102.59	21.65	2,518
Seaboard Corporation	2,278.76	794.35	4,640.00	795.00	2,518
Sysco Corporation	33.27	6.94	56.61	19.45	2,518
Tyson Foods Incorporated	27.24	16.69	76.76	4.40	2,518
Total	**223.957**	**663.17**	**4,640**	**0.25**	**30,017**

Table 2: Summary Statistics

Variable	*Observations*	*Mean*	*Std. Dev.*	*Min*	*Max*
Year	30,019	2011.73	2.86	2007	2016
Month	30,019	6.56	3.43	1	12
Beef	30,019	0.57	0.50	0	1
Pork	30,019	0.59	0.49	0	1
Chicken	30,019	0.50	0.50	0	1
Turkey	30,019	0.48	0.50	0	1
Eggs	30,019	0.25	0.43	0	1
Other Food	30,019	0.59	0.49	0	1
NonFood	30,019	0.25	0.43	0	1
MuliCommodity	30,019	0.48	0.50	0	1
Subsidiary	30,019	0.11	0.31	0	1
Parent	30,019	0.81	0.39	0	1
Assets (in billions)	30,019	11.00	18.60	0.18	12,300
Employees	30,019	29205.10	29915.23	128	124000
Experience	30,019	75.98	25.21	38	125
2007	30,019	0.09	0.29	0	1
2008	30,019	0.09	0.29	0	1
2009	30,019	0.08	0.28	0	1
2010	30,019	0.09	0.29	0	1
2011	30,019	0.10	0.30	0	1
2012	30,019	0.10	0.30	0	1
2013	30,019	0.11	0.31	0	1
2014	30,019	0.11	0.31	0	1
2015	30,019	0.11	0.31	0	1
2016	30,019	0.11	0.31	0	1
January	30,019	0.08	0.27	0	1
February	30,019	0.08	0.27	0	1
March	30,019	0.09	0.28	0	1
April	30,019	0.08	0.28	0	1
May	30,019	0.08	0.28	0	1
June	30,019	0.08	0.28	0	1
July	30,019	0.08	0.28	0	1
August	30,019	0.09	0.28	0	1
September	30,019	0.08	0.27	0	1
October	30,019	0.09	0.28	0	1
November	30,019	0.08	0.27	0	1
December	30,019	0.08	0.28	0	1

Table 3: Correlation Matrix (obs=27,499)

	WRDS Price	Beef	Pork	Chicken	Turkey	Eggs	Other Food	Non Food	Subsidiary	Parent Company	Assets	Employees	Experience
WRDS Price	1												
Beef	-0.16	1											
Pork	0.03	0.39	1										
Chicken	0.01	0.03	0.28	1									
Turkey	0.06	0.31	0.79	0.06	1								
Eggs	0.18	-0.36	-0.27	0.15	-0.54	1							
Other Food	0.01	0.77	0.63	0.28	0.42	-0.27	1						
Non-Food	-0.15	0.48	-0.27	-0.26	-0.13	-0.38	0.14	1					
Subsidiary	0.13	-0.46	0.33	-0.24	0.26	-0.22	-0.25	-0.22	1				
Parent Company	-0.38	0.65	-0.01	-0.02	0.00	-0.19	0.44	0.32	-0.71	1			
Total Assets	0.26	0.28	0.27	0.27	0.14	-0.20	0.27	0.02	0.01	0.12	1		
Number of Employees	-0.20	0.21	0.55	0.48	0.06	0.23	0.31	-0.21	0.07	0.09	0.17	1	
Years of Experience	0.17	0.29	0.21	-0.17	0.13	-0.22	0.57	-0.19	-0.03	0.11	0.03	-0.11	1

Table 4: Stock Price Analysis Results for U.S. Top Publically Traded Meat Businesses

	Coefficient	*Robust Std. Err.*	*t*	*P>t*	*[95% Conf. Interval]*	
Beef	1.14	1.365	0.830	0.406	-1.54	3.81
Pork	-27.25	3.890	-7.010	0.000	-34.88	-19.63
Chicken	17.55	2.300	7.630	0.000	13.05	22.06
Turkey	53.12	4.713	11.270	0.000	43.88	62.36
Eggs	29.59	1.726	17.150	0.000	26.21	32.98
Other	4.20	0.627	6.700	0.000	2.97	5.43
NonFood	14.20	0.624	22.750	0.000	12.98	15.42
MultiCommodity	-24.10	2.143	-11.250	0.000	-28.30	-19.90
Subsidiary	35.88	5.842	6.140	0.000	24.43	47.33
Parent	-3.17	2.174	-1.460	0.145	-7.43	1.10
Assets	0.00	0.000	42.250	0.000	0.00	0.00
Employees	0.00	0.000	-20.000	0.000	0.00	0.00
Experience	0.08	0.007	11.490	0.000	0.06	0.09
SP500	-0.01	0.001	-5.020	0.000	-0.01	0.00
SP500Lagged	0.02	0.001	24.760	0.000	0.02	0.02
2008	1.83	0.616	2.970	0.003	0.62	3.04
2009	3.11	0.962	3.230	0.001	1.22	4.99
2010	5.63	1.252	4.500	0.000	3.18	8.08
2011	4.67	1.601	2.920	0.004	1.54	7.81
2012	5.85	1.962	2.980	0.003	2.00	9.69
2013	11.81	2.317	5.100	0.000	7.27	16.35
2014	16.30	2.686	6.070	0.000	11.03	21.56
2015	16.39	3.057	5.360	0.000	10.40	22.38
2016	19.09	3.447	5.540	0.000	12.33	25.84
January	-1.84	0.392	-4.690	0.000	-2.61	-1.07
February	-1.67	0.368	-4.530	0.000	-2.39	-0.95
March	-1.27	0.339	-3.740	0.000	-1.93	-0.60
April	-0.78	0.325	-2.410	0.016	-1.42	-0.15
May	-0.10	0.318	-0.320	0.751	-0.72	0.52
June	0.20	0.301	0.670	0.505	-0.39	0.79
July	0.52	0.302	1.710	0.088	-0.08	1.11
August	0.42	0.297	1.430	0.153	-0.16	1.01
September	0.60	0.303	1.990	0.046	0.01	1.20
October	0.40	0.296	1.350	0.178	-0.18	0.98
November	-0.70	0.292	-2.410	0.016	-1.28	-0.13
Constant	195.26	42.086	4.640	0.000	112.77	277.75
Observations	25,699					
R^2	0.6902					