A Comparative Assessment of the Broiler:Corn Ratio and Its Impact on Broiler Processors' Profitability

Sandra J. Hamm

Department of Agricultural Economics and Agribusiness, University of Arkansas, 217 Agriculture Building, Fayetteville, AR 72701, e-mail: shamm@uark.edu

H.L. Goodwin Jr.

Department of Agricultural Economics and Agribusiness, University of Arkansas, 217 Agriculture Building, Fayetteville, AR 72701; Department of Poultry Science and Center of Excellence for Poultry Science, University of Arkansas, POSC O-114, Fayetteville, AR 72701, email: haroldg@uark.edu

Andrew McKenzie

Department of Agricultural Economics and Agribusiness, University of Arkansas, 217 Agriculture Building, Fayetteville, AR 72701; email: mckenzie@uark.edu

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Abstract: Input prices for broiler production, particularly corn, are becoming increasingly volatile due to increasing competition for corn from ethanol and biofuels production suggesting volatility in poultry profits will follow indicator of profits relating feed input prices and broiler meat output prices, such as a Broiler:corn ratios. Total chicken exports, total chicken ready-to-cook production, number of eggs set, number of chicks placed, and cold storage chicken inventory are used to estimate. Utilizing a distributed lag model, seventeen years of data for three Broiler:corn ratios, broiler exports, egg set, chick placements, cold storage stocks, and ready-to-cook broiler production were utilized to estimate stock share price for four major broiler producers.

Introduction

As food companies merge and acquisitions occur, share price and profits are affected. 1972-1992 was a period of rapid consolidation for food companies. This is particularly true for the broiler industry, where consolidation continues up to now. The number of food-processing plants has declined by approximately one third and worker numbers declined by 20%. However, in the poultry industry there has been an increase in both the number of plants and the number of workers due to vertical integration. Given the rapid concentration and consolidation of the poultry industry (Ollinger, 2005) and the fact that some of the largest poultry companies are diversified producers of beef and pork, empirical results thus far indicate industry structure could be a factor in the ability to respond to input and output price changes (McKenzie, et al).

The hog-corn ratio is still an indicator in today's production environment where intense growing practices are common and higher capital is required for specialized production. If the broiler-corn ratio is an indicator of company profits for poultry firms, they may benefit from predicted changes in market conditions due to price fluctuations and other factors. The predictability of the broiler:corn (B:C) ratio is of interest because decision makers may be able to anticipate, and therefore accommodate, price changes in one market and to predict not only the magnitude, but also the direction of firm profitability. Optimal results can be attained while limiting risks firms face.

Preliminary analysis found the effect of an increasing B:C ratio is to induce negative price response as a result of over-production (McKenzie, et al). The issue of company diversity could be a factor in negative price responses. The number one and three poultry producers are not diverse; the number two poultry producer leads the nation in beef production and ranks second in pork (Feedstuffs, 2007). The number two poultry producer is also the top U. S. food processing company. It is known that company size, diversity and market changes also impact overall company profits. The negative reaction of stock prices to a shock in product price could also indicate market inefficiencies.

This study will determine the magnitude and importance of the B:C ratio and other supply indicators, such as total chicken in cold storage, number of eggs set and chicks placed, broiler exports, prices per pound of whole broiler without giblets, boneless skinless breast and leg quarters corn price per bushel and total ready-to-cook broiler production on stock share price. Given adequate information, it is anticipated that professionals will be able to predict and adjust for change prior to its occurrence.

Objectives

The overall objective of this study is to determine the relationship among input and output prices and various supply indicators and stock share price across the period 1989-2005. Specific consideration will be given to the (B:C) ratio. Results of three model estimation techniques will be compared and contrasted with results obtained from utilizing VAR modeling of the B:C ratio to estimate share price given shocks to the B:C ratio. It is anticipated that insights will be gained regarding whether market information other than total reliance on prices over time are substantially beneficial in estimating stock share prices. Comparing and contrasting results from econometric and time series approaches should be instructive.

Background

The hog cycle has been used as an economic indicator for hog farmers for many decades. Hog cycles, on average three years in length, are recurring changes in production and prices and are often tied to the price of corn. They occur when producers respond to changes in market and economic conditions such as higher profits and increased sales by expanding their production operations.

One historical indicator of profit from hog production is the hog-corn ratio that reflects the relationship between hog and corn prices, specifically how many bushels of corn it takes to equal the value of 100 pounds of live hog ($ per hundredweight hogs/ $ per bushel corn). An indicator of pork production profitability, the hog-corn ratio reflects that as hog production rises, hog prices trend down and as it declines, prices trend up.

The hog-corn ratio can be used to predict profitability in hog production because feed represents 65-70% of production cost and corn is 60% of the feed source (Global Financial Data). The hog-corn ratio is a simple ratio of market hog price in dollars per 100 pound of cwt. to the price of corn in dollars per bushel (Holt 2006). For example, if the hog-corn ratio is 20, history shows that pork production will exceed that of the previous year in approximately 12-18 months. Similarly, a hog-corn ratio of 16 or lower predicts a decrease in production compared to previous year figures (Meyer 2006). This type of ratio is still an indicator in today's production environment where intense growing practices are common and higher capital is required for specialized production.

Because the ratio continues to work in pork production, the same concept using poultry production and corn prices could be an indicator of production profitability to poultry companies. These changes in pork production mirror changes in intensified and specialized poultry production that have occurred since the 1950s. Corn accounts for an even greater proportion of feed in poultry rations, upwards of 70 percent, so it is not inconceivable that a broiler-corn ratio[1], if developed, would be similarly useful as a profit indicator for poultry production. The National Chicken Council (NCC) considers escalating corn prices resulting from ethanol production subsidies as one of the industry's greatest threats in the coming years, a sentiment echoed by Keith Collins, USDA Chief Economist. Diversion of corn into ethanol and away from animal feed has already driven up the cost of feeding chickens by 45 percent. (Bill Roenigk, Dateline:Washington, D.C.)

Contributing to the timeliness of this research is the surge in ethanol production and government policies that continue to encourage corn grown for ethanol production. If the current trend of ethanol production continues, U. S. ethanol production could easily reach 11 billion gallons by 2011. This means the ethanol sector will need 4 billion bushels of corn per year, twice the amount consumed by the sector in 2006 (Baker 2007). According to Collins, the price signals for this increased production are in place. Recent USDA projections suggest that the extra corn will be diverted from exports and feed.

Changes in poultry sales and exports and near-record numbers of cattle and hogs on feed contributing to the market's 'protein glut' may buffer impacts of corn's decreased availability due to an estimated increase in ethanol production from 5.6 B gallons to 11.8 B gallons annual capacity when current plants are completed (Baker 2007). Decreasing profits for U.S. poultry integrators are directly tied to decreased end-product prices and increasing grain prices, making identification of an appropriately structured and useable broiler-corn ratio a possible key identifying profit opportunities in the industry and could lead to more appropriate decision making by industry professionals.

Data and Methods

Poultry price data are gathered from Urner-Barry for the following: price per pound for whole broiler without giblets (WOG), boneless, skinless breasts (BSB) and leg quarters (LQ). Poultry production data are gathered from USDA/ERS for the following: poultry in cold storage (CLD), ready-to-cook chicken production (RTC), total U.S. exports (EXP), total eggs set (EGGSET), total chicks placed (CHK). USDA/NASS monthly corn price data are used to formulate WOG, BSB, LQ broiler/corn ratios and the hog/corn ratio. Data for company stock share prices (1989-2005) are gathered from the Compu-Stat database within Wharton Research Data Services (WRDS) for the top four publicly-traded poultry companies and are signified by the letters A, B, C and D. Although companies A and C are diversified with respect to their meat offerings, the meat offerings of companies B and D are exclusively chicken-based.

The time series nature of the data set makes it necessary to test for unit roots so that an appropriate model formulation can be implemented. If unit roots are identified, the data are not stationary and must be first-differenced. The Dickey-Fuller Unit Root test will then determine the order of first-differences necessary. Results from a Dickey-Fuller test were negative for unit roots, indicating data were stationary and need not be adjusted.

The data set includes 204 observations and 10 variables: WOG ratio, BSB ratio, LQ ratio, CLD, RTC, HOG and four poultry company variables; A, B, C and D. Initial diagnostic tests on the data indicated that there was a high degree of correlation between two pairs of variables, EGGSET and CHK and CLD and EXP; therefore EGGSET and EXP were excluded from the model framework. A similar situation was apparent for the three broiler-cut ratios WOG, BSB and LQ because BSB and LQ comprise roughly 75% of the saleable meat on a broiler carcass. However, there is no *a priori* expectation as to which of the variables (WOG or BSB and LQ) should be included in the models. Thus, both are estimated as mutually exclusive. Upon these determination, three sets of modeling procedures were employed, Ordinary Least Squares, Maximum Likelihood and Polynomial Distributed Lag. Modeling structures for each are presented in turn.

Ordinary Least Squares Approach

A simple OLS model was estimated as indicated below:

$$\gamma_i = \alpha + \beta_1\chi_{1i} + \beta_2\chi_{2i} + \beta_3\chi_{3i} + \beta_4\chi_{4i} + \beta_5\chi_{5i} + \beta_6\chi_{6i} + u_i \quad (1)$$

Where:

y_i = dependent variable (stock share price lagged six months, i = A - D);

α = intercept;

χ_i = independent poultry market variables (CLD, RTC, WOG, BSB, LQ, HOG lagged six months) and

u_i = error term.

Maximum-Likelihood Approach

An ML modeling technique was applied to subsequent OLS estimations as:

$$\gamma_t = \alpha + \beta\chi_i + u_i; \qquad u_i \sim IN(0,\sigma^2) \quad (2)$$

Where:

γ_t = dependent variable (stock share price lagged six months; t = A – D)

β = column vector of structural variables;

χ_i = independent poultry market variables (CLD, RTC, WOG, BSB, LQ, HOG lagged six months) and

u_i = error term.

Polynomial Distributed Lag Approach

$y_t = \alpha + \sum \beta_i \chi_{t-i} + \gamma z_t + u_t$ (3)

Where:

y_t = dependent variable (stock share price lagged 6 months, t = A - D);

α = intercept;

χ_{t-i} = independent poultry market variables (CLD,RTC,WOG, BSB, LQ, HOG lagged six months);

z_t = simple covariant and

u_t = error term

Empirical Results

Ordinary Least Squares Results

Two separate Ordinary Least Squares regression models with a 6 month variable lag are employed. Two basic model constructs are estimated, one regresses RTC, CLD, WOG and HOG against stock share price (Table 1) and the second model regresses RTC, CLD, HOG, BSB and LQ against company share price (Table 2). Regarding the OLS results in Table 1, adjusted R-squares ranged from 0.2975 to 0.5627 for the four companies. Results suggest that the model predicts best for company B, with .01 observed significance levels (osl) for the parameter estimates for RTC, WOG and HOG. Results for company D are next best, with osl of .01 for RTC and .10 for WOG. Neither intercept estimate for company B or D are statistically significant. Company C parameter estimates are significant at the .05 osl for CLD and HOG, but the adjusted R-squared is low (.2975). Although the R-squared is .40 for company A, only the intercept and HOG parameter estimates are significant at .05 and .01, respectively. A similar pattern of results is seen for the models using BSB and LQ. Importantly, BSB is not statistically significant for any of the four companies analyzed, a surprising finding considering previous research (Goodwin, et al) identified BSB as the most important part of a broiler.

Maximum-Likelihood Results

The ML (maximum-likelihood) estimates used to correct for autocorrelation result in a better than average total R-squared, representing a model which explains structurally how well it will predict the next value and past values of the residuals. However, the regressed R-squared is extremely low signifying a poor model fit after transforming for autocorrelation (Tables 3 and 4). In addition, the final ML results reveal that the only parameter estimate statistically significant at .01 osl is that for the parameter AR1. It appears that the ML approach will not achieve the desired objectives of this research.

Polynomial Distributed Lag Results

The polynomial distributed lag (PDL) model considers the firms' cost parameters to determine the order of the lag distribution (Nerlove). The PDL construct utilized herein indicates average to better-than-average fits for all four companies, but also reveals the presence of positive autocorrelation in both models, the first employing WOG as a regressor (Table 5) and the second employing BSB and LQ as regressors. Because the results for the estimates utilizing BSB and LQ are marginally better in terms of R-squared and osl of parameters, these results will be discussed in depth; however, results shown in Table 5 are quite similar. The statistically most robust results are for estimates of share price for companies B and D, yielding R-squared of values of 0.7347 and 0.7414, respectively. Parameter estimates for company B are relatively strong statistically, with

RTC, BSB, LQ and HOG having at least one of the PDL parameter estimates for each variable significant at the .05 or better osl. The constant term for all four of these variables was highly significant statistically. Parameter estimates for company D were less robust; BSB estimates were not significant. Regarding companies A and C, R-squared values of 0.6478 and 0.5177, respectively, were achieved. Despite this, parameter estimates for company A were quite poor from a statistical standpoint with only two having any significance above .05; similar results followed for company C.

In summary, the econometric estimations of poultry market price and production variables regressed on the share price of the four leading poultry producing companies reveals mixed results. The OLS estimation shows statistical significance in several variables, but models for all companies have relatively mediocre low R-squared values ranging from 0.2975 to 0.5627, indicating rather poor model fits. The OLS also tests positive for autocorrelation. The next estimation, ML, corrects for autocorrelation but results in an extremely low regressed R-squared values. The PDL estimations result in much higher R-squared values (0.5177 to 0.7414) albeit with positive autocorrelation indicated. The two companies with the highest R-squared values had robust parameter estimates for the four poultry market and production variables. Recall that applying this estimation results in one error term directly affecting error terms on the other variables. Adjusting this estimation by applying a succession of finance variables, such as some sort of Standard & Poor's index for food companies, creating an exchange rate index or deflating share price could dampen the effects of positive autocorrelation.

Comparison with Vector Autoregressive (VAR) Results

Goodwin, et al utilized a Vector Autoregressive (VAR) approach to determine dynamic price relationships among different wholesale chicken cut ratios and poultry company share price. Specifically, the magnitudes and directions of price shocks in a particular market and its effect on other markets are analyzed. (Goodwin et al, 2003). Two of the firms analyzed in the VAR study (companies A and C) are also analyzed in this research manuscript. A shock to the BSB:corn ratio for one of these firms results in a (97% significance level) negative response in share price beginning immediately but becoming substantial by month seven and a continuing decline through month fourteen, at which time the share price recovers gradually through the end of the 36-month period, although remaining negative. The other company share price also reacts negatively to a shock in the BSB:corn ratio (97% significance level). This company's share price responds by small variation in price until month 5, when a sharp decline occurs through month 8, then oscillates between month 5 and 8 levels until month 18 and recovers slowly throughout the remainder of the period. In no case is decline as marked or does it fall to so low a level as for the other company's stock price. This more moderate response could be due not only to its large size as a broiler producer but also its diversity, being an active participant in both beef and pork. The other company, also diversified, holds a smaller proportion of the beef market and is not a player in the pork market.

The purpose of this comparative assessment is to identify the data and functional form that is most parsimonious, that is, what data are most accessible and needed in the least quantity and which functional form provides the most stable and accurate results. Although VAR results for two companies appear to offer similar conclusions to the econometric estimations performed herein, there is no allowance for other market or production factors impacting share price, a seemingly risky approach given the dynamic nature of the poultry industry as it becomes ever more concentrated and multinational in its operation, particularly in view of the interrelatedness of poultry cuts as further processed products evolve and as pork becomes increasingly integrated in its organizational structure both in the U.S. and internationally.

Conclusions and Implications

Given the rapid concentration and consolidation of the poultry industry (Ollinger 2005) and the fact that some of the largest poultry companies are diversified producers of beef and pork, empirical results thus far indicate industry structure could be a factor in the ability to respond to input and output price changes. Determining the predictability of the broiler-corn ratio is of interest for firms because decision makers may be able to anticipate, and therefore accommodate, price changes in one market and to predict not only the magnitude, but also the direction of profitability for the firm. Optimal economic results can then be attained while minimizing risk facing the traders in the markets.

In conclusion, the expected similarities between the hog-corn ratio and a broiler:corn ratio are confirmed with preliminary testing. The relationship brought an expected decline in price. The effect of an increasing broiler: corn ratio is to induce negative price response as a result of over-production. This is, in turn, reflected by a negative share price response. Future modeling utilizing additional variables and extended analysis intended to estimate actual changes in profit over the past twenty years will add robustness to this analysis and lend further support to the proposition that firm profit theory in the poultry industry should include some form of the broiler:corn ratio.

Table 1: Ordinary Least Squares Estimates using WOG B:C Ratios				
	A	**B**	**C**	**D**
INT	34.265[c] (2.233)	-16.248 (1.490)	50.198[c] (3.880)	-19.841 (3.540)
CLD	-2.850 (3.266)	-0.000 (2.179)	0.000[b] (5.675)	-0.000 (5.178)
RTC	-4.247 (1.604)	7.353[c] (1.071)	-6.515 (2.788)	0.000[c] (2.543)
WOG	0.2024 (0.099)	26.712[c] (4.984)	-79.025 (12.978)	22.565[a] (11.840)
HOG	-28.552[b] (7.468)	0.258[c] (0.066)	0.486[b] (0.173)	-0.290 (0.158)
R^2	**0.4004**	**.5627**	**0.2975**	**0.4956**

Table 2: Ordinary Least Squares Estimates using BSB LQ B:C Ratios				
	A	**B**	**C**	**D**
INT	40.326[c] (2.615)	-15.929 (1.756)	66.475[c] (4.733)	-21.141 (4.216)
CLD	-1.331 (3.424)	-0.000 (2.298)	9.174[b] (6.197)	-0.000 (5.519)
RTC	-8.899 (1.623)	6.844[c] (1.089)	-0.000 (2.937)	0.000[c] (2.616)
BSB	-6.613 (2.340)	-0.743 (1.571)	-20.558 (4.235)	1.774 (3.772)
LQ	51.624[c] (12.876)	49.588 (8.643)	48.261[b] (23.303)	34.180[b] (20.755)
HOG	-0.096 (0.097)	0.278[c] (0.065)	0.009 (0.175)	-0.273 (0.156)
R^2	**0.4188**	**0.5712**	**0.2615**	**0.4946**

Table 3: Maximum Likelihood Estimates using WOG B:C Ratios				
	A	**B**	**C**	**D**
INT	19.829 (4.273)	9.276 (11.850)	37.028 (6.114)	16.798 (9.066)
CLD	-1.755 (4.640)	-4.615 (2.102)	-7.048 (6.852)	-3.339 (8.29)
RTC	-4.826 (8.664)	-8.955 (3.689)	-1.918 (1.202)	3.317 (1.814)
WOG	1.239 (5.503)	0.107 (2.238)	-3.202 (7.961)	0.497 (10.614)
HOG	0.049 (0.104)	0.035 (0.041)	0.134 (0.150)	-0.138 (0.181)
AR1	-0.915 (0.072)	-0.913 (0.073)	-0.910 (0.072)	-0.771 (0.072)
AR2	0.039 (0.099)	0.003 (0.099)	-0.179 (0.098)	0.095 (0.091)
AR3	-0.025 (0.099)	-0.153 (0.100)	0.227 (0.098)	-0.074 (0.092)
AR4	0.067 (0.098)	-0.053 (0.101)	-0.091 (0.099)	-0.019 (0.092)
AR5	0.007 (0.098)	0.046 (0.100)	0.074 (0.098)	-0.090 (0.091)
AR6	-0.107 (0.072)	0.077 (0.076)	-0.048 (0.073)	-0.090 (0.074)
Regress R^2	0.0043	0.0049	0.0264	0.0187
Total R^2	0.8608	0.9596	0.8835	0.8237

Table 4: Maximum Likelihood Estimates using BSB LQ B:C Ratios				
	A	**B**	**C**	**D**
INT	20.422 4.296	9.068 (11.788)	37.775 (6.228)	19.870 (11.214)
CLD	-2.158 4.688	-2.847 (2.156)	-7.879 (6.947)	-6.117 (8.729)
RTC	-5.109 8.703	-8.946 (3.700)	-1.898 (1.206)	3.018 (1.777)
BSB	0.720 1.817	0.113 (0.734)	-0.871 (2.659)	5.690 (3.415)
LQ	-6.379 12.782	1.002 (5.250)	-6.183 (18.388)	-37.826 (24.113)
HOG	0.066 0.105	0.0312 (0.0417)	0.143 (0.150)	-0.101 (0.181)
AR1	-0.9150 0.072	-0.914 (0.073)	-0.908 (0.073)	-0.778 (0.072)
AR2	0.033 0.100	0.006 (0.100)	-0.184 (0.098)	0.099 (0.092)
AR3	-0.020 0.099	-0.155 (0.101)	0.230 (0.099)	-0.075 (0.093)
AR4	0.073 0.099	-0.052 (0.102)	-0.091 (0.099)	-0.048 (0.093)
AR5	0.005 0.099	0.045 (0.101)	0.073 (0.099)	-0.065 (0.093)
AR6	-0.106 0.073	0.076 (0.076)	-0.047 (0.073)	-0.099 (0.075)
Regress R^2	0.0058	0.0056	0.0285	0.0356
Total R^2	0.4188	0.9597	0.8838	0.4946

Table 5 : Polynomial Distributed Lag Estimates using WOG B:C ratios

	A			**B**			**C**			**D**		
	X**0	X**1	X**2	X**0	X**1	X**2	X**0	X**1	X**2	X**0	X**1	X**2
INT	37.325 ^{c} (2.558)			-25.342 (1.603)			48.361 ^{c} (4.711)			-37.765 (3.411)		
CLD	-4.062 (1.368)	-0.000 (3.952)	9.730 (8.080)	-8.728 (8.570)	-3.173 (2.477)	-8.923 (5.063)	4.617^{a} (2.519)	-0.000 (7.280)	-0.000 (0.000)	-0.000 (1.823)	-8.627 (5.270)	-0.000 (0.000)
RTC	-6.086 (7.337)	6.665^{b} (3.177)	-2.275 (3.276)	4.941^{c} (4.598)	2.633 (1.991)	1.170 (2.053)	-4.357 (1.352)	3.069 (5.851)	-2.157 (6.034)	0.000^{c} (9.783)	2.270 (4.236)	2.056 (4.368)
WOG	-12.814 (3.497)	-6.838 (7.162)	-13.328 (10.532)	7.659^{c} (2.192)	1.578 (4.489)	-0.713 (6.601)	-52.661 (6.442)	-7.348 (13.193)	-46.035 (19.400)	-1.224 (4.663)	1.867 (9.550)	-67.548 (14.043)
HOG	0.016 (0.043)	-0.193 (0.099)	0.043 (0.164)	0.164^{c} (0.027)	-0.183 (0.062)	0.290^{b} (0.103)	0.303^{c} (0.080)	-0.074 (0.182)	-0.008 (0.3017)	-0.084 (0.058)	-0.316^{b} (0.132)	0.648 (0.218)
R^2	**0.5624**			**0.7202**			**0.4274**			**0.7409**		

a= .90 significance, b=.95 significance, c=.99 significance, X**0 = constant term, X**1 = linear coefficient, X**2 = quadratic coefficient

Table 6: Polynomial Distributed Lag Estimates using LQ & BSB B:C ratios

	A			**B**			**C**			**D**		
	X**0	X**1	X**2	X**0	X**1	X**2	X**0	X**1	X**2	X**0	X**1	X**2
INT	48.745 [c] (2.825)			-27.078 (1.922)			85.938 [c] (5.323)			-40.575 (4.195)		
CLD	-6.199 (1.423)	-0.00 (3.995)	-3.487 (7.705)	-6.924 (9.679)	-5.459 (2.718)	-0.000 (5.242)	4.264[a] (2.681)	-3.317 (7.527)	-0.000 (0.000)	-0.000 (2.113)	-3.018 (5.932)	-0.000 (0.000)
RTC	-4.44 (7.005)	5.827[a] (3.044)	-9.807 (3.044)	4.568[c] (4.765)	8.614 (2.071)	2.248 (2.071)	-7.613 (1.32)	7.822 (5.737)	-6.795 (5.735)	0.000[c] (1.040)	4.358 (4.521)	1.802 (4.520)
BSB	-2.722 (1.007)	1.733 (2.094)	-6.383 (3.153)	1.221[a] (0.685)	3.245[b] (1.424)	-0.115 (2.145)	-15.989 (1.897)	-5.573 (3.945)	-13.78 (5.940)	0.636 (1.495)	-2.638 (3.109)	-7.051 (4.681)
LQ	40.299[c] (6.302)	-24.868 (12.767)	24.860 (18.980)	15.646[c] (4.287)	-10.213 (8.685)	-3.703 (12.911)	65.116[c] 11.875	65.594[b] 24.057	32.479 35.764	0.922 (9.358)	42.116[b] (18.958)	-67.876 (28.183)
HOG	-0.196 (0.040)	-0.236 (0.094)	-0.026 (0.151)	0.148[c] (0.027)	-0.200 (0.064)	0.340[c] (0.103)	-0.120 (0.074)	-0.480 (0.177)	-0.534 (0.284)	-0.083 (0.058)	-0.399 (0.140)	0.582[b] (0.224)
R^2	**0.6478**			**0.7347**			**0.5177**			**0.7414**		

a= .90 significance, b=.95 significance, c=.99 significance, X**0 = constant term, X**1 = linear coefficient, X**2 = quadratic coefficient

References

Baker, A., Zahniser, S., "Ethanol Reshapes the Corn Market", USDA/ERS *Amber Waves*, May 2007, p66-71.

Fatka, J., "Broiler, hog industries save billions from corn", *Feedstuffs*, Issue 13, v79, March 26, 2007

Feedstuffs, http://www.feedstuffs.com/ME2/Default.asp, January 15, 2007

Global Financial Data, http://www.globalfinancialdata.com/index.php3?action=detailedinfo&id=3433#metadata, accessed May 2007.

Goodwin, Jr., H. L., McKenzie, A. M, Djunaidi, H., "Which Broiler Part is the Best Part?", *Journal of Agricultural and Applied Economics,* 35,3(December 2003): 483-495.

Holt, M. T., L. E. Craig, "Nonlinear Dynamics and Structural Change in the U.S. Hog-Corn Cycle: A Time-Varying STAR Approach", *American Journal of Agriculture Economics,* 88(1) (February 2006): 215-233.

Lawrence, J., "Hog:Corn Ratio What Can We Learn From the Old School?", The Pig Site, http://www.econ.iastate.edu/outreach/agriculture/periodicals/ifo/documents/ifo101606_000.pdf, accessed May 2007.

Meyer, S., "Hog:Corn Ratio – Alive and Well", *National Hog Farmer*, March 10, 2006, http://nationalhogfarmer.com/marketpreview/hog-corn-ration/, accessed May 2007.

National Chicken Council, http://www.nationalchickencouncil.com/statistics/stat_detail.cfm?id=4, accessed May 2007.

Nerlove, M., D.M. Grether, J.L. Carvalho, "Analysis of Economic Time Series, A Synthesis", Revised Edition, Academic Press,, Inc., 1995.

Ollinger, M., Nguyen, S. V., Blayney, D., Chambers, B., Nelson, K., "Structural Change in the Meat, Poultry, Dairy, and Grain Processing Industries", USDA/ERS Research Brief, Resources and Environment, February 2005.

USDA/NASS, Statistical Bulletin 1003, Statistical Highlights of U.S. Agriculture for 2004-2005, April 2005, http://www.usda.gov/nass/pubs/stathigh/2005/stathi.txt, accessed May 2007.

USDA/NASS, Statistical Bulletin 1006, Statistical Highlights of U.S. Agriculture for 2005-2006, May 2006, http://www.usda.gov/nass/pubs/stathigh/2005/stathi.txt, accessed May 2007.

Watts, G., National Chicken Council, Statistics and Research," Chicken and Grain: Status and Projections", Annual Meeting May 2003

[1] Note: broiler feed contains 70% corn, 20% soybean meal hi pro, 6-8% meat and bone meal, 2% vitamins, mineral.