Determining Key Factors of Influence on the Profitability Of Retaining Cull Cows beyond Culling

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Abstract

Factors influencing the profitability of retaining and feeding cull cows beyond culling were investigated. First, a price response function is estimated using 19 years of monthly price data as reported by Agricultural Market Services (AMS). Net returns are then estimated using data from a three year cull cow feeding experiment conducted at The Samuel Roberts Noble Foundation and used to examine the relative effect of various factors on net returns. Results showed the importance of average daily gain increases across feeding periods while feeding system is also an important contributing factor to net returns.

Introduction

Cow-calf producers are often encouraged to consider retaining and feeding cull cows in order to market them into the seasonal price upswing that typically occurs after the first of the year (Roeber et al 2001; Amadou et al 2009; Blevins 2009; and Strohbehn and Sellers 2002).. However, most cow-calf producers traditionally cull and then immediately sell their cull cows in the fall when prices are at or near the seasonal low. Net returns from feeding cull cows fluctuate over time and across different management systems (Amadou et al. 2009). The differences are undoubtedly related to feeding cost, weight gain and the seasonal price differential. For instance, poor body condition scores and seasonally low prices have been identified as key physical and economic factors that limit the potential profit of cows in the fall (Feuz 1996, Spreen and Simpson 1992). In particular, the value added by the seasonal price movement is often discussed anecdotally. However, the relative importance of these individual factors has not been examined empirically and may vary across the feeding period. A greater understanding of these factors facilitates producer education in managing cull cows for added value through careful evaluation of market conditions relative to available producer resources. The purpose of this paper is to determine the influence of seasonal price movements, average daily gain (ADG), beginning weight, feed cost per gain and feeding method on net returns from feeding cull cows.

Theory

Cow calf producers are assumed to maximize net returns, given limited resources. Net returns are not only influenced by weight gain, but also by seasonal price movements and feed costs. Thus, with regard to cull cow feeding and marketing, any increase in profitability will likely be influenced by the beginning body condition score (BCS) of cull cows, availability and affordability of feeds, weight gain, and seasonal price increases. The cow-calf producer's objective function regarding cull cows can be expressed as follows:

$$\max_{M,F} E(NR) = P_{M,Q} W(M,l) - C_{M,F} \quad / M = 1,2,3,4,5, F = 0,1 \qquad (1)$$

where $E(NR)$ is expected net returns, P_{Mgt} is expected price of a given cow in month M (M=1,2,3,4,5) with quality grade Q (Q=1, 2,3), $W(M,F)$ is animal weight animal measured in month M, feeding method F(Fl= 0 for pasture and 1 for drylot), and $C_{M,F}$ are input costs at month M for feeding method F.

Data

Monthly average price data for slaughter cows in Breaker, Boner and Lean categories sold in Oklahoma City are used to estimate a price response function for slaughter cows. Data is used as reported in Agricultural Marketing Service (AMS) reports KO_LS155 and KO_LS795 from 1992 to 2010 and summarized by the Livestock Marketing Information Center. We also use data from a three year experiment carried out at the Samuel Roberts Noble Foundation in Ardmore, Oklahoma. In each of three culling years, data were measured at approximately monthly intervals for culls cows retained on dry lot with grain supplement or on native pasture/forage with mineral supplements. Specifically, data were collected for cows culled in October 2007 and marketed in April 2008, for cows culled in October 2008 and marketed in March 2009, and for cows culled in October 2009 and marketed in March 2010.

Data were collected approximately monthly on weight, USDA grade, dressing percentage, costs (feed, animal health, etc.), and market value. In total, 162 cull cows were randomly assigned to one of the two treatments. In treatment one, cows were fed in a dry lot environment (dry lot) with a grain supplement and forage. In treatment two, cows were fed in a grazing environment with forage only (grass). In year one, a total of 48 cows were fed, with 24 in each treatment. In year two, a total of 43 cows were fed, with 22 in the dry lot and 21 on grass. In year three, a total of 71 cows were fed, with 35 on dry lot and 36 on pasture. This data is a rich source for examining the relationship between net returns and the primary factors that influence returns, such as seasonal price differentials.

Procedure

The model requires estimation of a price response function for slaughter cows, the expected profit function, the net return function and standardized beta coefficients of each independent variable. The first objective of this paper is to estimate a price response function for slaughter cows and use it to assign a price for each cow at each feeding period. Since slaughter cow prices follow a seasonal pattern, cosine and sine function are included in the price response function to capture seasonality. Price response for slaughter cows is a function of the month and quality grade. The price response function is defined as follows:

$$(2)\; P_{Mgt} = \beta_0 + \beta_1 M + \beta_2 M^2 + \beta_3 M^3 + \sum_{g=1}^{2} \beta_g Q_g + \beta_6 Cos(\pi M / 6) + \beta_7 Sin(\pi M / 6) + \varepsilon_{dgt} + \mu_t$$

where P_{Mg} represents monthly average of price in Month M (M= 1, 2, 3,….12) at a given quality grade Q (g=1,2,3) , Q_g is dummy variable for quality grade, cosine and sine are used to capture seasonality of price , ε_{dg} is a random term with $\varepsilon_{dgt} \sim^{iid} N(0,\sigma_{\varepsilon}^2)$, and μ_t is a year random effect with $\mu_t \sim^{iid} N(0,\sigma_{\mu}^2)$. The price response function is estimated using the maximum likelihood procedure available in the SAS PROC MIXED assuming year random effects.

The price response function is then used to estimate net returns for an individual cow at each period are estimated as the difference between revenues at the marketing period and at culling less additional feeding cost associated with retaining cull cows on dry lot or pasture systems, Expected net returns are specifically defined as follows:

$$E(NR_{ijt}) = E[P\,(M,Q,t)](W_{ij} - W_{io}) - \sum_{i=1}^{5} C_{ij} \qquad (3)$$

where NR_{ijt} is the net return for cow i at month period j and year t, P(M,Q,t) is the expected price as a function of month M , quality grade Q, and time period t, W_{ij} is the weight for cow i at month j, W_{i0} is cow i's weight at culling, and C_{ij} is the cumulative feeding cost for cow i at month j.

To determine the relative importance of factors affecting net returns from feeding cull cows, the following equation was estimated:

(4) $E(NR_{ijt}) = \alpha_0 + \alpha_1 ADG_{ijt} + \alpha_2 W_{io} + \alpha_3 COG_{ijt} + \alpha_4 \text{Price}_{ijt_t} + \alpha_5 F$

where $E(NR_{ijt})$ is expected net returns for cow i at month j and year t, ADG_{ijt} is the average daily gain for cow i at month period j and year t, W_{ic} is the beginning weight for cow i at culling, COG_{ijt} is the cost per pound of gain for cow i. in month period j, and year t ,Price_{ijt} is the price for cow i, month period j , and year t. F is dummy variable for feeding method (1= dry lot, 0= pasture). This model was estimated for feeding periods ending at 35 days, 63 days, 91 days, 126 days, and 155 days using SAS PROC GLIMMIX procedure assuming year random effects.

The units of the variables in equation (4) are different; thus, the magnitudes of the individual regression coefficients cannot be directly compared. Therefore, variables were first transformed to stabilize the variance so as to compare relative importance of independent variables. These variables were regressed on the normalized net returns generating standardized beta coefficients (SBC). SBC for each variable was calculated from a regression model to determine their individual influence on net returns. To compute standardized beta coefficients, we followed similar method outlined by Brooks et al (2009):

$$\frac{NR - \overline{NR}}{\sigma_{NR}} = \sum_i \alpha_i \frac{x_i - \overline{x}}{\sigma_{x_i}} + \mu \qquad (5)$$

where NR is the net returns, σ is the standard deviation, x_i is the i^{th} independent variable of interest and α_i is the SBC for the i^{th} independent variable. The new coefficients were computed as follows:

$$\alpha_i^* = \alpha_i \frac{\sigma_{x_i}}{\sigma_{NR}} \tag{6}$$

The SBC are proportions and therefore the absolute value can be used to rank the relative importance of the explanatory variables. Coefficients are interpreted such that if independent variable increases by one standard deviation, then net returns changes by α_1^* standard deviations (Wooldridge, 2006).

Results

This section summarizes results from the price response function for slaughter cows, the net return function at various feeding periods, and the percentage increase of key important variables considered to having strong influence on net returns. Figure 1 shows that prices estimated by the price response function were relatively low in October to November and high in March through April. This price pattern is reflective of the typical seasonal price pattern.

Table 1 presents regression results for the price response function. Results indicate that month squared and month cubic were statistically significant and alternate in sign. Quality grade coefficients were both positive and statistically significant indicating that Boner and Breaker quality grades bring a premium over cows that grade as Lean. This is supported by Wright (1995) who reported that improving quality grade can significantly increase cull revenue. The additional seasonality effect of price is captured by cosine and sine functions included in the price response function model. Both coefficients are negative, but only the sine coefficient is statistically significant.

Table 2 summarizes regression results of net returns across feeding length. Results shown in table 2 revealed average daily gain (ADG) and feeding methods was positive and statistically significant regardless of the feeding length. It is also worth noting that ADG increases as the feeding length increases. This implies that ADG is positively related to net returns. Similarly, feeding method (grass or drylot) was negative and significantly related to net returns regardless of the feeding length. This implies that retaining cull cows on a grass/pasture system is more profitable than a grain fed system regardless of the length of feeding.

Figure 2 indicates that ADG and feeding method are the most important factors attributed to net returns fluctuations. Figure 2 also shows that ADG and feeding method contribution to net returns increases as the feeding length increases. The third most important affecting net return fluctuation is seasonal price movement. However, figure 2 revealed that the contribution of seasonal price movement is somewhat ambiguous characterized by an increase followed by a decrease

Table 3 summarizes the standardized beta coefficients at 35, 63, 91, 126, and 155 days corresponding to November through March when cull cows were retained and fed on pasture and dry lot systems in the Noble Foundation experiment. Results shown in table 3 indicated that average daily gain followed by feeding method and seasonal price movement were the most important factors affecting net returns when cull cows were retained and fed at 35 and 63 days. Under 91 and 155 days, feeding methods followed by ADG and seasonal price movement were the most important factors affecting net returns.

Results also indicated that ADG followed by feeding method and seasonal price movement at 126 days were the most important factors attributed to net returns.

This means ADG was the most important factors, followed by feeding method and seasonal price movement. The contribution of ADG, feeding method and seasonal price reached their peak at 126 days and followed by 91 days. These results are consistent with previous research that concluded ADG was the most important factors related to net returns (Brooks et al 2009, Amadou et al, 2009).

Summary and conclusions

A number of researchers have argued the importance of seasonal price on net returns from feeding cull cows. Most of them unanimously agreed that the key to understand cull cow net returns is the seasonal price movement, but this relationship has not been investigated empirically. To determine the influence of seasonal price movement on net returns, we first develop a price response using 19 year data from 1992 to 2010 reported by Agricultural and Marketing Services (AMS).This price response function was then used to assign price value to 162 cull cows used in the three year experiments (2007 - 2010) conducted the Noble Foundation Ranch, Ardmore. Revenues at culling and beyond culling were also estimated using the price response function. Net returns for each cow at each feeding were also determined as the difference between revenue beyond culling and revenue at culling and feed cost associated with feeding and caring for cull cows. Results indicated not only date, but also quality grade are key factors in understanding price response function.

The standardized beta coefficients determine the impact of each independent variable on net returns. Results showed that ADG, feeding method and seasonal price movement are the most important factors explaining cull cow net return fluctuations overtime regardless of the feeding length. In conclusion, cow-calf producers should consider ADG, Pasture system, and seasonal price movement and more importantly their own resources when considering retaining and feeding cull cows.

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Table 1.Paramater Estimates for Slaughter Cow Price Response Function as a Function of Month and Yield Grade

Parameters	Independent Variables	Estimates
β_0	Intercept	42.00* (2.781)
β_1	Month	0.324 (0.238)
β_2	Month squared	-0.441* (0.224)
β_3	Month cubic	0.032* (0.017)
β_4	Breaker	7.69** (0.790)
β_5	Boner	7.07* (0.790)
β_6	Cosine	-4.175 (1.479)
β_7	Sine	-0.874* (1.771)
σ_{ϕ}^{2}	Variance of error tem	62.698
-2LL	-2Log likelihood	4210.4

The parameter estimates were estimated using PROC MIXED in SAS Parentheses are Standard errors, *, ** denote statistical significance at 5% and 10% level respectively.

Table 2. Net returns as function of average daily gain, beginning weight, feed cost per gain, price and feeding method

	Description	35 days	63 days	91 days	126 days	155 days
Intercept	Intercept	-1.725	-3.438*	-5.295*	-1.530*	2.824*
		(1.253)	(2.018)	(3.593)	(4.55)	(5.764)
ADG	Average daily gain	0.114*	0.231*	0.34*	0.567*	0.609*
		(0.006)	(0.014)	(0.032)	(0.043)	(0.070)
LBW	Log(beginning weight)	0.04	-0.171	0.222	0.562	-0.255
		(0.141)	(0.223)	(0.354)	(0.5)	(0.556)
FCG	Feed cost per gain	-0.001	0.019	0.027	0.06*	0.007
		(0.004)	(0.024)	(0.024)	(0.025)	(0.028)
LP	Log(Price)	0.340	1.202*	0.848	-0.857	-0.505
		(0.236)	(0.38)	(0.712)	(0.817)	(1.037)
FMD	Feeding method	-0.157*	-0.736*	-0.967*	-1.329*	-1.529*
		(0.029)	(0.046)	(0.072)	(0.105)	(0.113)
Scale parameter		0.031	0.08	0.207	0.387	0.511
	Scale	(0.004)	(0.09)	(0.023)	(0.044)	(0.058)

The parameter estimates were estimated using PROC GLIMMIX Procedure in SAS with year random effects, * Statistical significance at the 5% level, N=162.

Table 3. Standardized beta estimates for net returns as a function of key variables and across feeding periods

Variables	Description	Standardized beta at 35 days	Standardized beta at 63 days	Standardized beta at 91 days	Standardized beta at 126 days	Standardized beta at 155 days
Intercept	Intercept	0.015	-0.297	-0.694	-1.123	-1.519
ADG	Average daily gain	3.533	4.987	5.245	9.384	6.727
LBW	Log of beginning weight	0.055	-0.235	0.305	0.773	-0.350
FCG	Feed cost per gain	-0.059	0.220	0.509	1.528	0.182
LP	Log of Price	0.262	0.930	0.562	-0.698	-0.358
FMD	Feeding methods dummy	-0.999	-4.687	-6.156	-8.456	-9.700

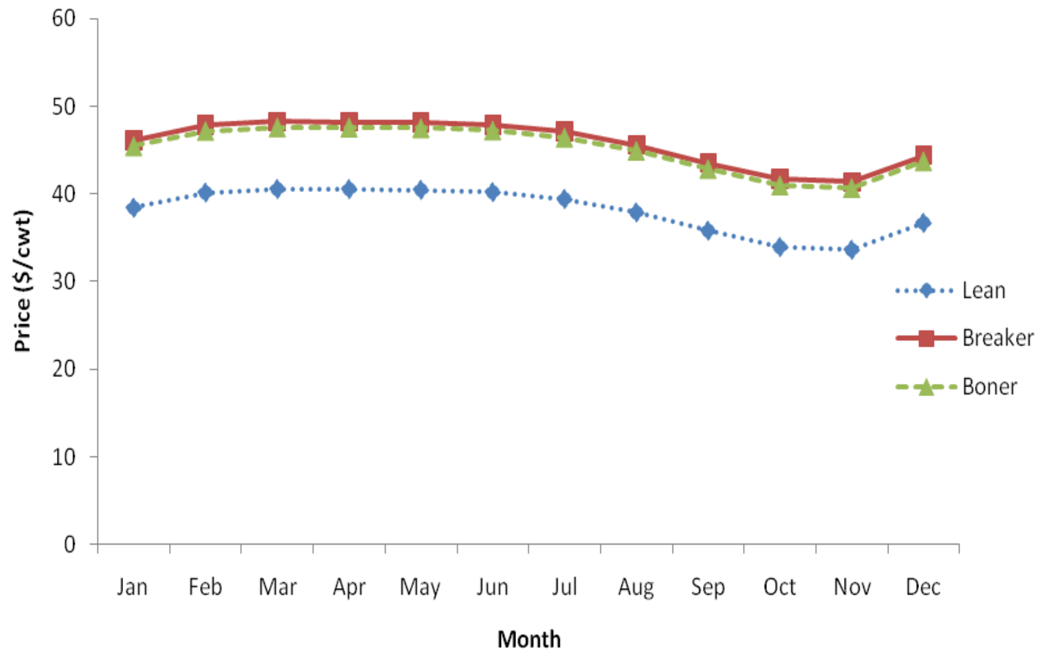

Figure 1. Slaughter Cow Price Response as a Function of Month and Quality Grade

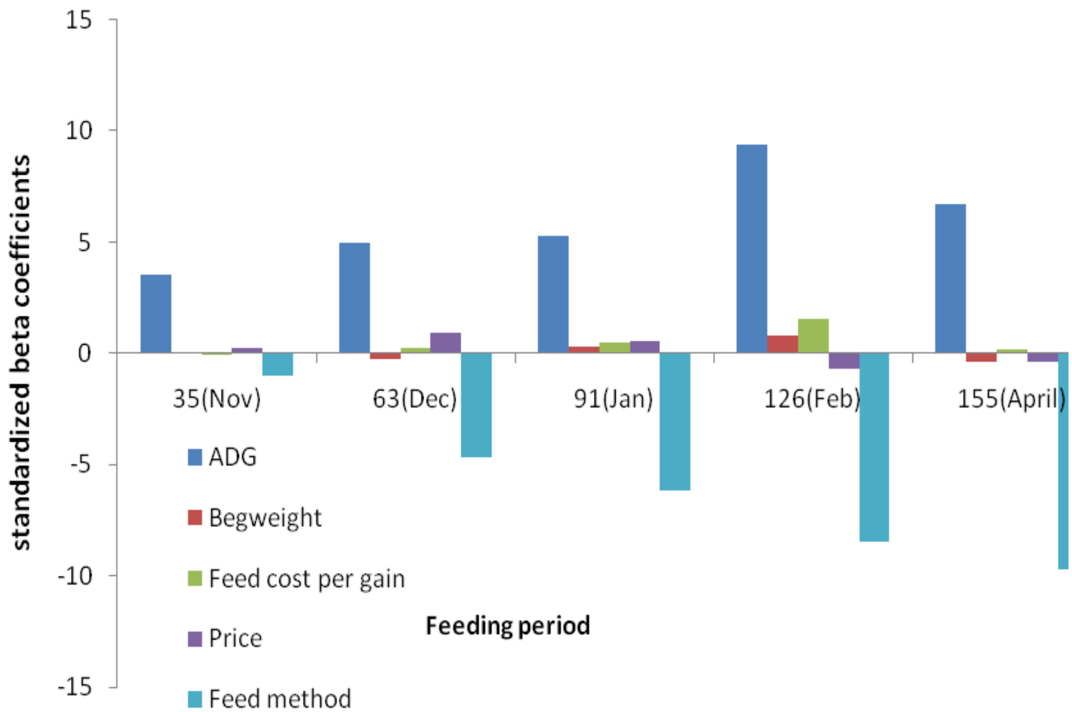

Figure 2.Standardized beta for net returns as a function of key variables