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Purchasing and Selling Decisions of Beef Cattle Replacement Females

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Adapted from: Boyer, C.N., A.P. Griffith, and K.L. DeLong. 2021. Evaluating Optimal Purchasing and Selling Decisions of Beef Cattle Replacement Females. *Agricultural Finance Review* Forthcoming.

Introduction

Production, management and marketing practices vary from one cow-calf producer to the next. However, many cow-calf producers face similar decisions that occur on a frequent basis. One such decision is when to sell and replace a beef cow. The objective of this work is to determine the most profitable age of replacement females to purchase and later sell considering pregnancy status and gestation (months bred). The intent of this publication is to provide information that will assist cow-calf producers in making investment decisions for their cow herd and positively contribute to long-term profitability. We hope this publication demonstrates the impact selecting replacement females and reproductive management can have on profits.

The first part of the analysis was conducted to determine the impact of age, pregnancy status, cull cow price, breed and females confirmed pregnant via artificial insemination (AI) on the sale price of replacement females. The second and third part of the analysis were related and include determining the net present value (NPV) of beef replacement female profitability, and the variability of NPV. NPV was used to evaluate this decision, because it provides a method of aggregating the initial investment cost (purchase cost or opportunity cost of not selling a heifer), the annual returns (production cost and revenue from calf sell), and the salvage value (value when sold) of the replacement female into one value. Additionally, it was important to consider the variability of NPV. Variability of NPV gives us insight into the riskiness of the investment of a female. Thus, the higher the expected NPV, the more profitable the replacement female. However, higher variability could impact the probability of returning a positive NPV.

This analysis evaluates how NPV changes when replacement females were bought and sold at various ages and stages of pregnancy. The main objective of this analysis is not to predict actual NPV for each scenario but to demonstrate the economic implications of purchasing a pregnant female and selling her open at different ages. We assume heifers or females that were five months pregnant could be purchased at two, three, or four-years old. Females were assumed to be sold at age five, seven, nine or twelve, and they could be either open or five months pregnant. All 12-year old females were assumed to be sold open.

Data, collected from 2009 to 2018, originated from an annual registered cow and heifer sale conducted in November at the University of Tennessee Plateau AgResearch and Education Center located in Crossville, Tennessee. Registration information included registration number, pedigree and current EPDs. Summary statistics of the data are in Table 1. A total of 241 lots of females were sold from 2009 to 2018 with lot sizes ranging from one to four head. The average sale price over the ten-year period was $1,616/head. On average, females were between four and five years old with the pregnancy status ranging from open (zero) to seven months pregnant. Additionally, monthly Tennessee price data (2001-2018) for 80-85 percent boning cow prices was collected to establish a cull cow price (USDA AMS 2019).

Table 1. Summary Statistics of Female Lots Sold from 2009 to 2018 at the University of Tennessee Plateau AgResearch and Education Center (number of lots was 241)

Variable	Mean	Standard Deviation	Minimum	Maximum
Price ($/head)	1,616.88	609.13	697.34	3,689.49
Age	4.32	2.19	0.73	11.39
Months Bred	3.45	2.81	0.00	7.13
Percentage of Pens Artificially Inseminated	10%	0.29	0.00	1.00
Cull Cow Price ($/cwt)	59.53	18.41	40.94	105.25
Lot Size (head)	2.47	0.56	1.00	4.00
Number of Lots	24	4.48	20	32
Percentage of Lots Mixed	4%	0.200	0	1
Percentage of Lots Angus	79%	0.406	0	1
Percentage of Lots Gelbvieh	14%	0.344	0	1
Percentage of Lots Balancer	3%	0.168	0	1

*Of the 595 females sold, 176 were open or 29 percent. This accounted for 72 of the 241 lots evaluated.

Source: Boyer, C.N., A.P. Griffith, and K.L. DeLong. 2021. Evaluating Optimal Purchasing and Selling Decisions of Beef Cattle Replacement Females. *Agricultural Finance Review* Forthcoming.

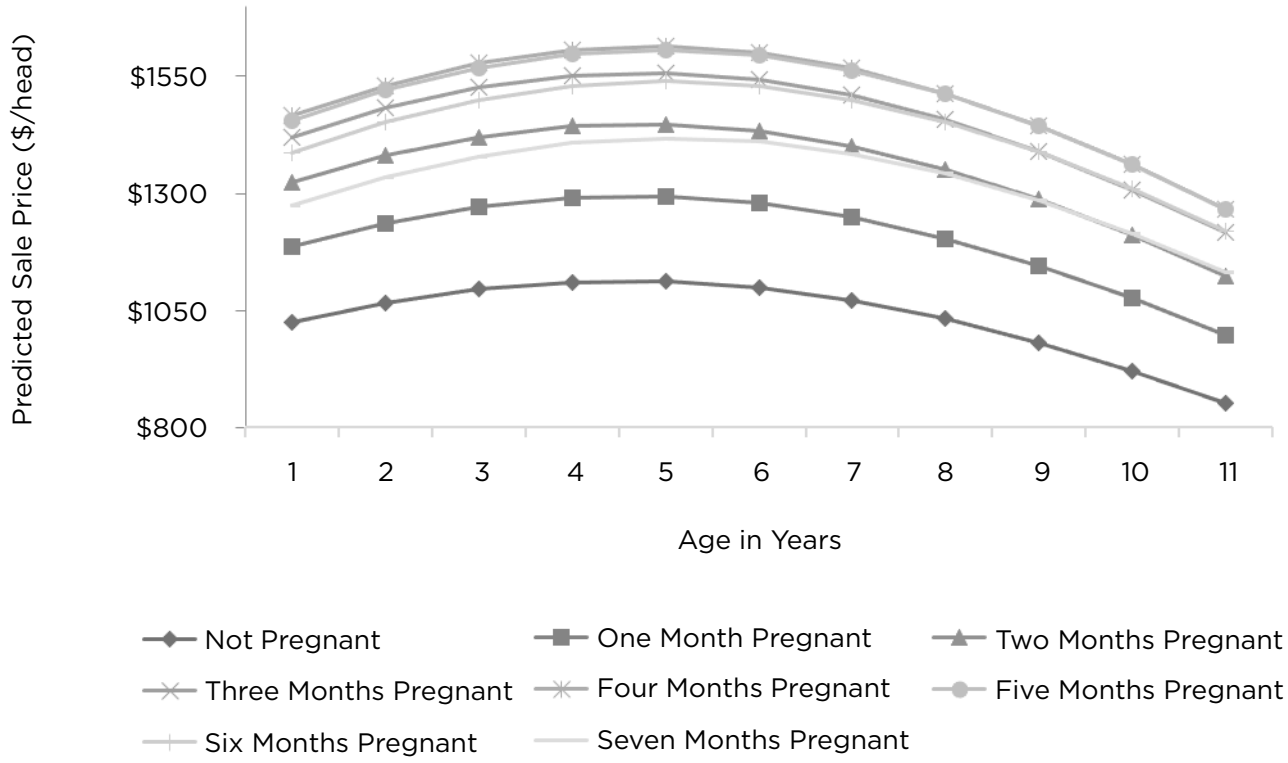
A few assumptions should be noted. The first assumption was annual variable costs for the spring-calving herd of $550 per head. The assumed calving rates were 90 percent for three- to nine-year-old cows; 85 percent for 10- and 11-year-old cows; and 80 percent for a 12-year old cow. Calving rates were varied to represent typical calving rates by cow age to determine the profitability of purchasing these bred females. We understand calving rates are an assumed value and will vary across herds. Regardless of the assumed calving rates, the result will still demonstrate how selling an open female when purchased pregnant can hurt profitability.

Results

Beef cattle replacement female prices were highest for females that were four to five years old and four to five months pregnant. AI-sired pregnancies did not increase sale price which differs from some previous research (Parcell et al., 2006) but is consistent with other research (Boyer et al., Forthcoming). However, higher cull cow prices at the time of replacement female purchase was found to increase the price of replacement females. Additionally, lots with only Angus cattle brought $127/head more than lots with multiple breeds, while Gelbvieh lots brought $135/head more.

Predicted prices of females by age and months bred is depicted in Figure 1. Females that were four to five months pregnant have the highest sale prices, followed by three- and six-months pregnant females. Females that are not pregnant or only one month into gestation sold for the lowest prices. The lower price for females that are not bred or only one month into gestation is reflective of the risk of breeding cattle and the cost incurred prior to the cow calving. It was expected that the longer bred an animal was the higher the price. However, given the data is from a November sale, four to five months bred would result in the cow calving in February/March, which aligns with most producer's established calving season. This may be why six to eight months bred cattle did not receive a higher price than those four to five months bred. Additionally, producers place value on females that are proven to produce calves over younger females, but they also show caution when purchasing older females.

Figure 1. Predictive Sale Prices for Female Beef Cattle Sold ($/head) from 2009 to 2018 at the University of Tennessee Plateau AgResearch and Education Center



Source: Boyer, C.N., A.P. Griffith, and K.L. DeLong. 2021. Evaluating Optimal Purchasing and Selling Decisions of Beef Cattle Replacement Females. *Agricultural Finance Review* Forthcoming.

The lowest NPV occurred when purchasing a pregnant four-year old and selling an open female a year later (-$567/head) (Table 2). The NPV of purchasing a pregnant female increased if that female was later sold as a pregnant female relative to selling her as an open 12-year-old. There are several scenarios where the expected NPV of purchasing a pregnant female is negative. Most of these scenarios are for buying a pregnant replacement female and selling her as open. The tables demonstrate the importance of reproductive management and selecting replacement females on the cow-calf producer's long-term profits.

Table 2. Expected Net Present Values ($/head) for Buying Pregnant Beef Cattle Replacement Females and Selling at Various Ages and Pregnancy Status

Age and Pregnancy Status when Sold		Age of Pregnant Female when Purchased			
		Heifer	Two Years Old	Three Years Old	Four Years Old
5	Open	-299	-367	-437	-567
	Pregnant	161	86	-12	-112
7	Open	-154	-221	-327	-413
	Pregnant	272	212	98	-18
9	Open	-62	-129	-236	-307
	Pregnant	311	265	137	20
12	Open	96	28	-78	-195

Source: Boyer, C.N., A.P. Griffith, and K.L. DeLong. 2021. Evaluating Optimal Purchasing and Selling Decisions of Beef Cattle Replacement Females. *Agricultural Finance Review* Forthcoming.

Risk varies across the evaluated scenarios, and Table 3 shows the probability of NPV being positive for each scenario. Despite the finding that selling a nine-year-old pregnant cow was the most profitable scenario, the likelihood of having a positive NPV was higher for other scenarios. This demonstrates the tradeoff between the highest NPV and more certainty of a positive NPV.

Table 3. Probability of a Positive Expected Net Present Value ($/head) for Buying Pregnant Beef Cattle Replacement Females and Selling at Various Ages and Pregnancy Status

Age and Pregnancy Status when Sold		Age of Pregnant Female when Purchased			
		Heifer	Two Years Old	Three Years Old	Four Years Old
5	Open	19%	6%	0%	0%
	Pregnant	65%	62%	48%	7%
7	Open	39%	31%	16%	2%
	Pregnant	67%	66%	60%	47%
9	Open	47%	42%	32%	19%
	Pregnant	65%	64%	59%	52%
12	Open	54%	51%	42%	38%

Source: Boyer, C.N., A.P. Griffith, and K.L. DeLong. 2021. Evaluating Optimal Purchasing and Selling Decisions of Beef Cattle Replacement Females. *Agricultural Finance Review* Forthcoming.

Summary and Conclusions

Decisions associated with replacing breeding stock are frequent, but they are also complex decisions impacting long-term profitability. The research objective was to determine the age and pregnancy status for purchasing replacement beef females and determining when to sell them. Sale prices were found to be highest for females four to five months pregnant with prices increasing until age five before starting to decrease. The NPV of selling an open female before the end of her productive life, who was purchased pregnant, is generally negative, which demonstrates the importance of reproductive efficiency.

References

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