Benefit–Cost Analysis of Selling Pregnant Replacement Females: Information and Timing Matters

Cattle producers often make decisions to sell cows or heifers as replacement females at cattle auctions. This decision can involve some uncertainty. Cow-calf producers face a series of questions when making the decision to sell a replacement female, such as:

- When was she last in standing heat?
- Is she pregnant?
- Should she be pregnancy-checked before sending her to auction?
- Is sales timing adjustable?
- Should length of pregnancy affect sales timing?

Before deciding to liquidate prospective replacement females, sellers should understand how buyers value replacements, costs of keeping replacement females, and net returns over time. Understanding the changes in net returns over time can better inform the seller when, if possible, selling replacement females may optimize their profits. The goal of this publication is to provide information as to when it may be most beneficial to sell replacement female cattle, especially pregnant ones. The following analysis provides a road map for market timing decisions given the available market information and individual production costs.

Buyer Valuation

When buyers develop their valuation for replacement females, they must first assess her ability to conceive, carry a live calf to term, and then care for the calf until weaning. Buyers construct these assessments based on the animal's physical characteristics and information provided by the seller (e.g., body condition, age, health status, and months pregnant).

Though being pregnant is a good signal to the buyer of the female's ability to conceive, buyers also realize the risks associated with purchasing unknown replacement cows or heifers. For instance, the female may have conceived, but what is the probability the female will actually carry a live calf to term? The highest risk of abortion in cattle is during early and mid-gestation (Forar et al., 1995; Santos et al., 2004).

Data collected from Mississippi cattle auctions from May 2014 to May 2015 (Parish et al., 2018) were analyzed to answer questions about buyer valuation of pregnancy in replacement female cattle. This analysis focuses on pregnancy status and how far along each individual female is in pregnancy. In this dataset, 75 percent were pregnant, 25 percent were open (not pregnant), and 17 percent were cow-calf pairs of which some were pregnant. **Figure 1** displays the distribution of months pregnant for replacement females. Within this dataset, there are more replacements sold in the earlier stages of pregnancy than later into pregnancy, with the average sales time being 3.45 months pregnant.

The buyer valuation of pregnancy status results is depicted in **Figure 2**, assuming a breed type identified as a grade (commercial or not registered) Angus replacement female. It is important to note that breed type does not affect the incremental increase in the value of months pregnant. In this example, an open replacement female of this type was valued at $1,863/head, while an open pair was valued at $2,267/head. Interestingly, buyers generally discounted pregnant females by an estimated $97/head as compared to an open replacement. However, values increase by $21.32/head for each additional month of pregnancy. Pregnant females did not receive a premium over open status until

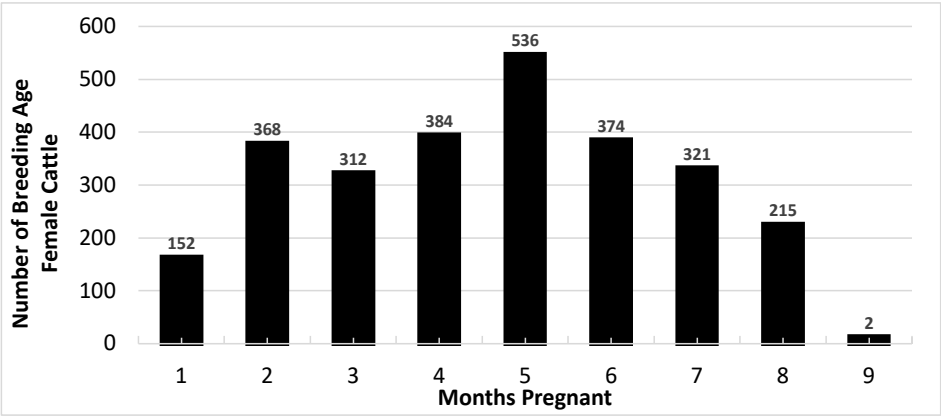

Figure 1. Distribution of months pregnant in cattle sold at Mississippi auction markets, 2014–2015.

they exceeded 5 months pregnant. The increasing value is indicative of buyers accounting for the declining risk of abortion as a female approaches calving.

What if sellers do not determine pregnancy status of cattle before taking them to an auction market? If a pregnancy check is not completed on the cow-calf or heifer development operation, it will typically be performed immediately before the sale by a licensed veterinarian hired by the auction market. The seller is faced with a gamble as to whether the female is pregnant or open. The expected value from taking that gamble is $1,800, regardless of when the producer decides to sell the female. The expected value is taken from the summation of three probabilities:

1. the probability she is not pregnant multiplied by her value as not pregnant,
2. the probability she is pregnant multiplied by her discounted value as pregnant, and
3. the probability of each month of pregnancy elapsed (1–9 months) multiplied by her value at each month in pregnancy.

This results in a total reduction of $63 in expected value as compared to an open female and a $116 reduction in expected value if the animal is 7 months pregnant.

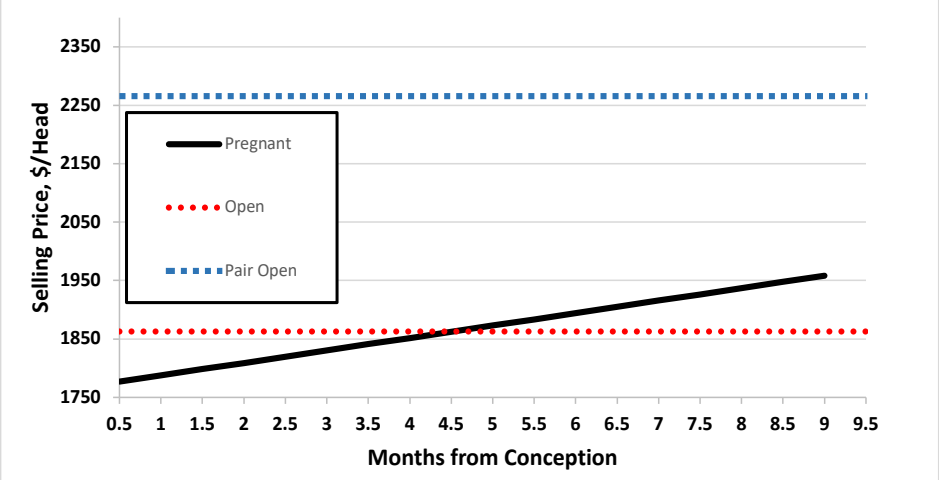

Figure 2. Replacement female cattle value: Mississippi auction markets, 2014–2015.

Pregnancy Diagnosis and Retention Costs

To make informed decisions and take full advantage of the premiums, pregnancy status must be known. Retaining females intended for sale, however, is costly, and pregnancy-checking on the operation also comes at a cost. For a cow herd with 30 breeding-age females, pregnancy diagnosis at the operation typically costs $6 to $10 per head. A flat-rate farm-call fee of $75 or more may also be charged by a veterinarian conducting on-farm pregnancy diagnosis.

To derive net returns, monthly retention costs are determined by using the Mississippi State University Extension cow-calf budget for 2018. These costs are general to Mississippi and are meant as an example only. The budget values used are shown in **Table 1**. The monthly cost of retaining a replacement female using this budget is approximately $37 dollars. However, note that costs and input use will vary from operation to operation and over time.

One additional cost you should account for is the risk of losing the calf of a retained female. The probability of abortion and losing the calf varies from month to month in gestation and again during calving. Although a buyer is willing to pay an additional $21.32/head for each additional month in pregnancy, the seller accepts the risk of abortion and possibly losing the calf before weaning as an expected cost. The higher expected cost is anticipated for producers who choose to retain their pregnant replacements until calving to receive the $309 premium. The expected cost of this risk is approximately $22 per head.

Net Returns and Optimal Sales Timing

The optimal time to sell a known pregnant replacement female depends on the level of net returns over time. The net return is calculated by subtracting the cumulative costs of retention, pregnancy diagnosis, and expected cost of assuming risk of calf loss from the value of the replacement female. The following analysis is conducted for a seller who pregnancy-checks 30 head and confirms a replacement female committed to be sold is 2 months pregnant.

Figure 3 displays the net value returns over the entire course of pregnancy and calving after costs are deducted. This value includes the increase in value of a replacement female as she moves farther along in pregnancy but also the associated costs for retaining the female. If a producer decides to sell a female now regardless that she is pregnant, he or she receives a discount of $63, making the animal's value $1,800. If the producer considers retaining the female until 5 months into gestation to eliminate the discount for pregnancy status, he or she must account for the additional costs of retaining the female for an extra 3 months. Reaching the 5-month threshold in pregnancy

duration would increase the value of the replacement female to $1,873. However, after deducting the costs of retaining the female for an additional 3 months plus pregnancy checks and the risk of abortion, the value of the female is $1,752.

What if the producer decides to hold the pregnant female until she calves? At the 11-month mark in Figure 3, the increase in value comes from the replacement female being sold as a pair. If the producer decides to retain the pregnant female until calving, this would mean an added 9 months of costs. Two months are added to the costs of retention after calving for the calf to build immunity before going to auction. After deducting the costs of retaining the female, her value as a pair is still greater than at any point in pregnancy or the expected value a producer could receive by taking her to auction without any knowledge of pregnancy. Therefore, for this scenario, the greatest value a producer could receive for his or her replacement females is when they have calved and are open again.

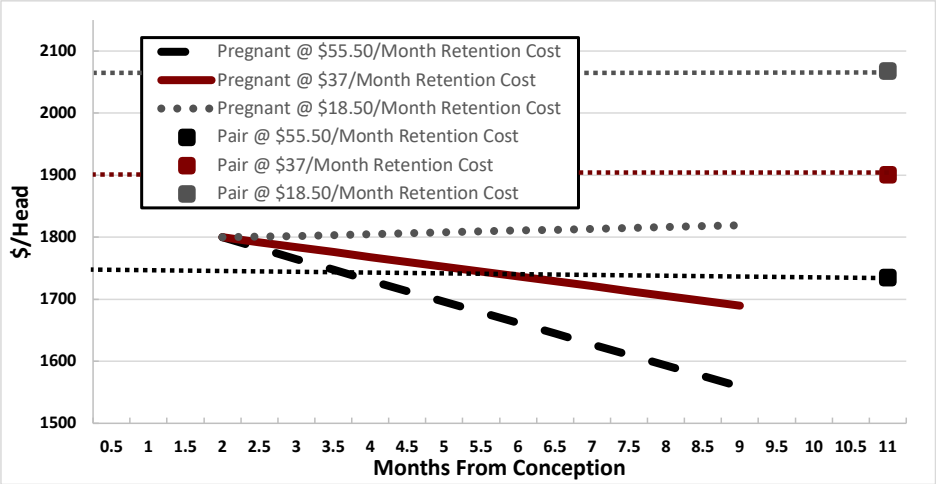

Figure 3. Expected net returns of a pregnant female over time versus a non-pregnant cow-calf pair.

Expected net returns of pregnant female = value of female - retention cost (months from pregnancy check) - pregnancy check cost - expected cost of abortion

Expected net returns of cow-calf pair = value of pair - retention cost (months from pregnancy check) - pregnancy check cost - expected cost of abortion - expected cost of calf loss

Table 1. Costs of maintaining a pregnant female and a cow-calf pair to sale: Mississippi, 2018.

Input description	Input use	Unit	$/unit	Cost ($/head)
Purchased and raised feed	1.00	dollars/head	50.00	50.00
Supplement	0.25	tubs	50.00	12.50
Hay	1.00	large round bales	40.00	40.00
Salt and mineral	25.00	pounds	0.50	12.50
Raised feed cost	0.00	dollars/head	0.00	0.00
Summer grazing cost[a]	1.00	dollars/head	141.67	141.67
Winter grazing cost[b]	1.00	dollars/head	120.00	120.00
Fuel, lube	1.00	dollars/head	35.00	35.00
Repairs and maintenance	1.00	dollars/head	0.00	0.00
Marketing and hauling	1.00	dollars/head	8.00	8.00
Veterinary medicine	1.00	dollars/head	25.00	25.00
Farm overhead	1.00	dollars/head	0.00	0.00
Total retention cost per year				444.67
Monthly retention cost				37.05
Pregnancy check cost[c]				8.50
Expected cost of abortion[d]				2.00
Expected cost of calf loss[e]				22.00

[a] $170 per summer season / 1.2 head per acre stocking rate.
[b] $240 per winter season / 2 head per acre stocking rate.
[c] Typical on-farm charge in Mississippi is $6/head for pregnancy diagnosis plus a $75 service fee. Given a typical average herd size of 30 head (Coblentz, 2018), the charge would be $8.50/head.
[d] The probability of abortion by month of gestation (starting with month 2) is 3.5, 2.5, 1.5, 0.5, 0.25, 0.1, and 0.1%, respectively (De Vries, 2006). The expected costs for assuming the risk of abortion is, therefore, $0.75, $0.53, $0.32, $.11, $0.05, and $0.02, respectively. Calculate cost as $21.32/head × probability.
[e] Assuming a 7% probability of losing the calf during calving or before selling (APHIS, 2010), calculate cost as $309 premium/head × 0.07.

What if costs are considerably greater or less? This analysis also considers two other scenarios:

1. costs are 50 percent higher (dashed black line) and
2. costs are 50 percent lower (dotted gray line).

This analysis demonstrates that the best time to sell pregnant females to optimize net returns depends on when the pregnancy check is performed. A producer with greater retention costs should sell now if pregnancy is confirmed early in gestation. However, if the producer has a 5-month pregnant female, it is better to hold her until she calves. A producer with less retention costs should retain at any point in pregnancy rather than selling now. However, the greatest value still comes from waiting to sell as a pair; and if the producer takes advantage of pregnancy-checking on the operation, he or she can optimize profits by retaining ownership if the pregnant female is close to calving.

Conclusion

Mississippi State University research results suggest that waiting to learn the pregnancy status of replacement-quality females at the auction is a pure gamble and reduces expected profit. Producers who opt to pregnancy-check on the farm are better situated to take advantage of improved profits by selecting the best time to sell. Optimal sale timing depends on the producer's retention costs and the timing of pregnancy check. A producer with relatively low retention costs can optimize profits by selling a cow-calf pair, regardless of when pregnancy is confirmed. However, if retention costs are relatively high, the producer should consider pregnancy-checking and selling early in gestation unless the female is later into gestation. If this is the case, just as when retention costs are relatively low, the producer is better off waiting to sell a cow-calf pair. Pregnancy-checking early in gestation also allows the producer to sell immediately if the female is found to be open and, therefore, avoid additional retention costs. Finally, given that the results of this study depend on retention costs, it is important for producers to maintain adequate production cost records to determine the best time to sell replacement females.

Important Note

Producers should be aware that the size of the discount for pregnancy and the increasing incremental value of pregnancy status may not be consistent across time. For example, the prices for this study were collected in 2014 and 2015 when market prices were relatively high. The expected direction of the premiums and discounts likely holds across time, but the price levels could adjust as market prices adjust. Further research is needed to assess the stability of these premiums and discounts over time.

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