EFFECTS OF WEATHER ON AVERAGE DAILY GAIN AND PROFITABILITY

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Summary

The effect of several weather conditions on average daily gain (ADG) and profits is quantified for typical steers and heifers fed in commercial feedyards in Western Kansas from 1980 to 1999. ADG predictions for particular pens of cattle are often used to plan marketing dates and calculate break-even purchase prices. Weather is known to influence cattle performance, and expected weather conditions can be used to improve ADG predictions. Effects on ADG and profits from combinations of, and interactions between, temperature, precipitation, humidity, and wind speed were analyzed. The influence of these weather conditions was allowed to differ by sex, placement weight, and placement month. Results indicate that performance and profits of lightweight placements are more sensitive to temperature and precipitation changes than are heavier weight calves. Above average temperature tends to reduce cattle performance during the summer and increase it for cattle fed during the winter.

(Key Words: Cattle Performance, Average Daily Gain, Cattle Feeding Profits, Temperature, Weather.)

Introduction

Cattle feeding budgets rely on predicting average daily gain (ADG) for steers placed on feed at various weights and times of year. Typically, historical averages and feedyard manager experience are used to forecast ADG for particular pens of cattle. Historical averages of cattle performance are based on season-average weather conditions. Deviations from normal or average weather conditions lead to better or worse cattle performance. Anticipating how, and to what degree, various weather conditions impact cattle performance is essential for cattle feeders to consider in break-even budgeting.

Changes in cattle performance resulting from favorable or adverse weather conditions generally affect profits. Cattle feeders must understand how weather affects cattle feeding profits when making production and risk-management decisions. For example, investment in facilities to reduce cold weather stress in winter can have the opposite effect during the summer. Performance and profit gains from such facilities during winter-feeding periods may be offset by reductions in performance and profit for summer feeding.

Previous research has concentrated on how short-term and unique weather events affect performance of individual or small groups of cattle over short time periods. In this study, we examine how average weather conditions during conventional feeding periods impact performance and profitability of typical feedlot cattle.

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Experimental Procedures

Two commercial feedyards in southwestern Kansas provided data for 17,715 pens of steers and heifers (over 2.3 million head) placed on feed from January 1980 to November 1999. The data included information on ADG, cattle purchase and sale prices, feeding cost of gain, and dates on feed. Using this information, profit for each pen was calculated. Daily weather records were obtained from the Kansas Weather Data Library for locations that were in close geographical proximity to the two feedyards. Weather variables were computed based on the daily weather records for each pen of cattle to describe the environmental conditions (e.g., temperature, precipitation, wind speed, humidity) during the time the pen of cattle was on feed. Statistical models were then estimated to quantify the effect of weather variables on cattle feeding performance and profit.

The average ambient air temperature during the feeding period was used to identify effects of cattle's thermal environment on performance. Optimal cattle feeding performance generally occurs when temperature is between 40 and 60 degrees Fahrenheit. When temperatures are colder, maintenance energy increases, and when they are hotter feed consumption declines, resulting in less weight gain. Temperature variability can further reduce cattle performance. Cattle performance is also affected by precipitation, which can increase stress on cattle by creating muddy pen conditions and wet, matted hair coats. Cattle response to temperature and precipitation is likely to be more pronounced at the beginning and end of the feeding period, which is accounted for in the model. Environmental stress at the beginning of the feeding period comes at a time when cattle are stressed from shipping and are most susceptible to respiratory diseases. Weather stress at the end of the feeding period can also reduce performance. Wind speed influences the extent to which cattle become stressed from thermal conditions, i.e., high wind speed exacerbates the affect of cold temperatures in the winter whereas it relieves heat stress in the summer. High humidity levels also can increase heat stress on feedlot cattle. Wind speed and relative humidity levels were used to measure the effect of cold and heat stress on performance.

Results and Discussion

The effects of weather on ADG and profit differed by cattle sex, placement weight, and placement month. A 1-degree higher average temperature over the feeding period improved ADG for average pens of lightweight steer and heifer placements by 0.01 and 0.02 lbs/day, respectively, and increased profits by $0.40/head and $0.48/head. The effect of temperature was nonlinear and had numerous interaction terms. Therefore, for example, these results cannot be multiplied by 5, for a 5-degree temperature differential. Heavyweight placements had smaller changes in profits from a 1-degree temperature change.

The average change in ADG and profits across pens of steers placed at 700-799 lbs in each month associated with a one-degree higher average temperature during each cattle placement month are depicted in Figures 1 and 2. The standard deviation lines are included in the figures to demonstrate the variation in estimates of the magnitude of changes in ADG. For example, Figure 1 shows that ADG increases 0.01 lbs/day on average if the average temperature over the feeding period increases by 1 degree (i.e., was 1 degree higher than during the previous year for the same time period) for steers placed on feed in January. A 1-degree increase in average feeding period temperature results in an increase in ADG between -0.004 and 0.023 lbs/day 68% of the time for January placements.

For steers placed on feed from March through June, a higher average temperature

generally caused ADG to decrease, corresponding to summer feeding periods with seasonally highest temperatures. ADG declined by over 0.01 lbs/day and profits decreased more than $0.20/head for May steer placements if temperature was 1 degree higher. Variability in the change in ADG and profits from a change in average temperature was greatest for steers fed during the summer months. Higher average temperatures over the entire feeding period resulted in higher ADG and profit per head for cattle placed on feed in the late summer/early fall because they were on feed during the typically coldest time of the year (winter and early spring).

A 1% increase in the percent of days with cold stress (low temperatures and high wind speeds) reduced profits by approximately $0.15/head for average cattle fed during the winter. For cattle fed during the summer, a 1% increase in the percent of days with heat stress (high temperature, high humidity, and low wind speed) lowered profits for the average pen of cattle by $1.00/head. Precipitation during the first 3 weeks and last 3 weeks of a feeding period adversely affected profitability by about $0.60 to $0.70/head, depending upon cattle weight and season of the year.

Cattle feeding performance and profits were most influenced by temperature, temperature variability, heat stress, and precipitation, especially at the beginning and end of the feeding period. During cold months, increasing temperature is beneficial, whereas higher temperature tends to be detrimental during warmer periods. Steers and heifers placed at light weights were influenced more by temperature and precipitation relative to heavyweight placements. Results indicate that cattle perform better and realize higher profits when weather conditions remain relatively stable over the feeding period.

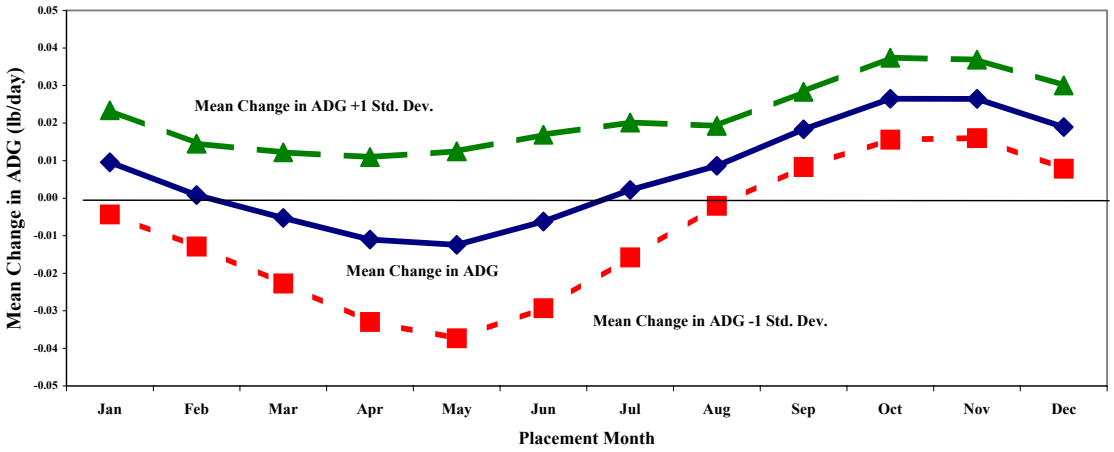

Figure 1. Predicted Change in ADG over the Feeding Period Resulting from a 1 Degree Increase in Average Temperature Compared to the Previous Year, by Placement Month. (Steers placed at 700-799 lbs in Western Kansas, 1980-1999.)

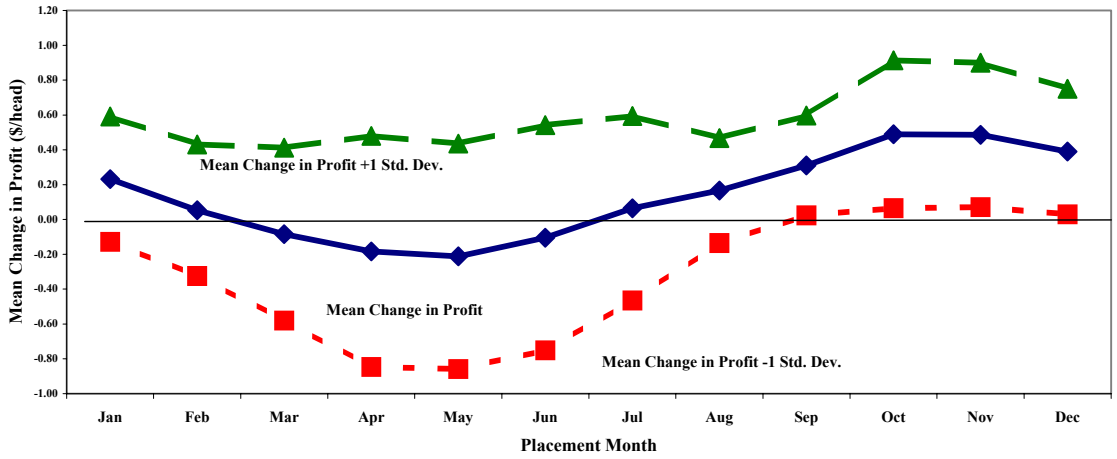

Figure 2. Predicted Change in Profit Per Head Over the Feeding Period Resulting from a 1 Degree Increase in Average Temperature Compared to the Previous Year, by Placement Month. (Steers placed at 700-799 lbs in Western Kansas, 1980-1999.)