NORTH DAKOTA STATE UNIVERSITY DEPARTMENT OF AGRIBUSINESS AND APPLIED ECONOMICS

Weather Risk Effects on Cattle Production and Profitability in North Dakota

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Authors: BillieJo A. Shae and Joleen C. Hadrich

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BillieJo A. Shae and Joleen C. Hadrich, Department of Agribusiness & Applied Economics, North Dakota State University, Fargo, ND 58103
billiejo.shae@my.ndsu.edu, joleen.hadrich@ndsu.edu

Introduction

- Cattle inventories in North Dakota reported by USDA-NASS were at 1.70 million head in 2011
- 2008 Feedlot Survey (USDA-NASS) reported less than 103,000 head of cattle are fed to slaughter in North Dakota.
- What does this mean?
  - Large opportunity for growth in North Dakota's cattle feeding sector.
- What obstacles are of concern for growth of this sector?
  - Effects of harsh northern winters on production yields (ADG) and production cost (feed to gain ratio).
  - Cost of transportation of fed cattle to slaughter facilities.

Research Objective

- Evaluate the effects of cold stress and precipitation variables on average daily gain and feed efficiency of weaned steers placed on feed in the fall in East-Central North Dakota .
- Determine the effect that average daily gain and feed efficiency have on the profitability of cattle fed in North Dakota to determine if North Dakota's extreme winter weather causes the production variables to have a greater impact on profitability than those seen in warmer states.

Data

- Production Data
  - NDSU-CREC Dakota Feeder Calf Show
    - 2005
- Weather Data
  - North Dakota Agricultural Weather Network (NDAWN)
    - Avg. Daily Temp
    - Avg. Daily Wind Speeds
    - Daily Precipitation/Snowfall Totals

Cold Stress Calculations

- Temperatures falling below 45°F:
  - $WCI = 0.081*(3.71*ADW^{0.05}+5.81-ADW*0.25)*(ADT-91.4)+91.4$
- Temperatures between 59°F and 46°F:
  - $CSI = [(ADT-45/14)]*ADT+[(59-ADT)/14]*WCI$

- ADT = Average Daily Temperature
- ADW = Average Daily Wind Speed
- WCI = Wind Chill Index
- CSI = Cold Stress Index

	Time	Level 1	Level 2	Level 3
Dry heavy	Jan1-Mar 31	19-10	9-0	<0
Dry spring	Apr 1-Apr 30	45-32	31-18	<18
Dry summer	May 1-Oct 15	59-46	45-32	<32
Dry fall	Oct 16-Nov 30	45-32	31-18	<18
Dry winter	Dec 1-Dec 30	32-20	19-7	<7
Wet	Year-round	59-46	45-32	<32

- Belasco and Cheng (2011, Working Paper)

Data/Summary Statistics

	ADG		F:G	
Variables	Coeff.	SE	Coeff	SE
Ration1	0.057	0.053	-0.053	0.084
Ration2	0.032	0.053	-0.096	0.084
Ration3	-6.433***	0.573	21.391***	0.907
Heavy	0.392***	0.070	-0.202	0.111
Med-Heavy	0.236***	0.067	-0.147	0.106
Med-Light	0.155**	0.062	-0.165	0.099
Natural Wind Break	-0.095**	0.044	-0.022	0.070
Days on Feed	0.073***	0.023	-0.153***	0.036
LVL 1	-0.086**	0.033	0.191***	0.053
LVL 2	-0.066***	0.017	0.155***	0.027
LVL 3	-0.064***	0.022	0.109***	0.034
Precipitation (in)	-0.785**	0.313	2.043***	0.496
Snowfall (in)	0.023***	0.007	-0.020	0.011
Intercept	9.237***	0.581	-11.106	0.920
R^2	0.898		0.981	
Adj R^2	0.884		0.979	
SER	5.137		12.861	
	Ln(Profit)			
Variables	Coeff.	SE		
Ln(Purchase Price)	-1.605***	(0.176)		
Ln(Selling Price)	2.504***	(0.287)		
Ln(Feed Cost)	-0.401***	(0.035)		
Ln(ADG)	0.010	(0.021)		
Ln(F:G)	0.004	(0.013)		
Intercept	2.487***	(0.060)		
R^2	0.944			
Adj R^2	0.941			
SER	0.006			

**P-value <0.01
*P-value<0.05

Model

- $ADG = f(Ration_i, Block_i, WbN, LVL_i, Prec, Snow)$
- $F:G = f(Ration_i, Block_i, WbN, LVL_i, Prec, Snow)$
- $LN(Profit) = f(LN(PP, SP, FC, ADG, F:G)$
  - $Ration_i$ = Dummy variable for types of rations fed
  - $Block_i$ = Dummy variable for weight block (L, ML, MH, H)
  - WbN = Dummy variable for natural wind break vs man-made
  - LVL_i = # of days in feeding period at each level of cold stess
  - Prec = Total rainfall in inches during the feeding period
  - Snow = Total snowfall in inches during the feeding period
  - PP = Purchase Price per pound
  - SP = Selling Price per pound
  - FC = Feed Cost per pound of gain
  - ADG = Average daily gain per animal in lbs
  - F:G = lbs of feed per lb of gain per animal
  - Profit = Net profit per animal

Method

- Ordinary least squares (OLS)

Results

ADG:

- For every one day increase of cold stress at the LVL1 there is a .08 lb decrease in ADG. This level is most common at the beginning and end of the feeding period.
- LVL2 and LVL3 are also significant with ADG decreasing at .06-.07 lbs for every additional day of cold stress at these levels.
- Rainfall decreases ADG by .79 lb for every additional inch, like LVL1 cold stress this weather variable is most common at the beginning and end of the feeding period.
- Snowfall had increasing effect on ADG with an additional inch of snow increasing ADG .02 lb.

F:G:

- For every one day increase in each level of cold stress there is a .10-.20 lb increase in the pounds of feed consumed per pound of gain. LVL1 cold stress like ADG has the largest effect on F:G.
- Precipitation had a large effect on F:G with a 2.0 lb increase in the feed to gain ratio with each inch of rainfall.

Profit

- Production variables did not appear to have a significant effect on profits in this model. The indicates that although cold stress and precipitation have significant effects on the production variables it did not affect the profitability of the feedlot for this production period.

Further Considerations

- Additional years of data from NDSU-CREC will be evaluated to compare effects of cold stress across years using fixed and random effects models