Assessing Efficiency of U.S. Cow-Calf Operations: Kansas

Hannah E. Shear, Kansas State University
Dustin L. Pendell, Kansas State University
Richard F. Nehring, USDA Economic Research Service

The findings and conclusions in this presentation are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy. This presentation was supported by the U.S. Department of Agriculture, Economic Research Service.
US BEEF INDUSTRY

COW-CALF & SEEDSTOCK

BACKGROUNDERS & STOCKERS

SALE BARNs

FEEDYARDS

PACKERS
CONSOLIDATION
More than 105,000 cow-calf farms have been lost since 1997.

RETAINED OWNERSHIP
An increase of 10% in ownership retention since 2008.

INCREASED BACKGROUNDING
12% increase in use of backgrounding prior to marketing for cow-calf producers.

FEEDLOT MIGRATION
86% of feedlot production is located in the plains region.

Trends in the Beef Cattle Industry
NUMBER OF U.S. COW-CALF FARMS BY HERD SIZE

Average herd size is 43.

US Cow-Calf Industry
Herd Size Over Time

An 8% increase in herd size over 44 years.

1974: 40.3 head
1997: 40.5 head
2018: 43.5 head
Returns to Management & Profitability

Kansas Farm Management Association 2017
Given that profitability has been so variable over time, but herd size is not changing, what might be causing certain producers to be more efficient?
Objective

Estimate production efficiencies for Kansas Cow-Calf producers.

Identify characteristics of production (selling feeders vs selling calves) that might affect efficiency.

Determine if herd size affects efficiency.
Method & Data

**KANSAS FARM MANAGEMENT ASSOCIATION**


**DATA ENVELOPMENT ANALYSIS**

Non-Parametric approach to estimating efficiencies. Does not require estimating a production function.
## Data - KFMA

### Descriptive Statistics – Kansas Farm Management Association: 2018 Cow Calf Production

<table>
<thead>
<tr>
<th></th>
<th>Producers Selling Calves (N=94)</th>
<th>Producers Selling Feeders (N=79)</th>
<th>Total (N=173)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Herd Size (hd)</td>
<td>120</td>
<td>12</td>
<td>560</td>
</tr>
<tr>
<td>Pasture Acres</td>
<td>1,162</td>
<td>30</td>
<td>6,600</td>
</tr>
<tr>
<td>Gross Income ($)</td>
<td>89,789</td>
<td>7,812</td>
<td>357,469</td>
</tr>
<tr>
<td>Labor ($)</td>
<td>19,437</td>
<td>1,835</td>
<td>143,422</td>
</tr>
<tr>
<td>Capital ($)</td>
<td>16,879</td>
<td>259</td>
<td>98,574</td>
</tr>
<tr>
<td>Feed ($)</td>
<td>56,844</td>
<td>3,565</td>
<td>247,669</td>
</tr>
<tr>
<td>Utilities/Fuel ($)</td>
<td>3,928</td>
<td>48</td>
<td>17,647</td>
</tr>
<tr>
<td>Veterinary ($)</td>
<td>4,036</td>
<td>0</td>
<td>36,002</td>
</tr>
<tr>
<td>Miscellaneous ($)</td>
<td>7,559</td>
<td>376</td>
<td>36,971</td>
</tr>
</tbody>
</table>
Method: Data Envelopment Analysis

This approach defines a non-parametric frontier and measures the efficiency of each unit relative to that frontier.

DEA uses linear programming to construct a frontier that envelops all observations and computes the relative Technical Efficiency of each farm included in the sample.

We use an output orientation with one output (Gross Income) and 6 Inputs.

We have two production systems in the data set: those that background and those that do not.
Method: Data Envelopment Analysis

**Technical efficiency**: the ability of a firm to either produce the highest level of output with a set input bundle and technology or to produce the current level of output with the lowest level of inputs.

**Allocative efficiency**: evaluates if a firm is using the optimal bundle of inputs.

**Scale efficiency**: compares a firm's current operational size with what is most efficient in terms of minimizing average cost.
Inputs

HERD SIZE
LABOR
FEED & PASTURE EXPENSE
FARM UTILITIES & FUEL
VETERINARY EXPENSE
MISCELLANEOUS EXPENSES

Outputs

FARM INCOME
## Technical Efficiency

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.712</td>
<td>0.754</td>
</tr>
</tbody>
</table>

| SELLING CALVES | SELLING FEEDERS |

39 DMU's were technically efficient (23%)
Technical Efficiency

KFMA Technical Efficiency Distribution
Cow-Calf Producers 2018, N=173
Scale Efficiency

.878  SELLING CALVES

.867  SELLING FEEDERS

1 DMU WAS SCALE EFFICIENT
Allocative Efficiency

<table>
<thead>
<tr>
<th>0.700</th>
<th>0.710</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELLING CALVES</td>
<td>SELLING FEEDERS</td>
</tr>
</tbody>
</table>

4 DMU'S WERE ALLOCATIVELY EFFICIENT (2%)
## PRODUCTION ELASTICITY ESTIMATES

### Production Parameter Estimates for Cow/Calf Producers in Kansas 2018

<table>
<thead>
<tr>
<th>Farm Income</th>
<th>Selling Calves</th>
<th>Selling Feeders</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd Size</td>
<td>0.866**</td>
<td>0.907**</td>
<td>0.895**</td>
</tr>
<tr>
<td>Labor</td>
<td>0.014**</td>
<td>-0.150</td>
<td>-0.014</td>
</tr>
<tr>
<td>Feed</td>
<td>0.017**</td>
<td>0.132</td>
<td>0.046**</td>
</tr>
<tr>
<td>Utilities</td>
<td>-0.005**</td>
<td>0.050</td>
<td>-0.002</td>
</tr>
<tr>
<td>Vet</td>
<td>-0.048**</td>
<td>0.024</td>
<td>-0.054**</td>
</tr>
<tr>
<td>Misc.</td>
<td>0.174**</td>
<td>0.095</td>
<td>0.166**</td>
</tr>
<tr>
<td>Constant</td>
<td>5.667**</td>
<td>5.567**</td>
<td>5.709**</td>
</tr>
</tbody>
</table>

### Inefficiency Variables

<table>
<thead>
<tr>
<th>0 to 120 cows</th>
<th>Selling Calves</th>
<th>Selling Feeders</th>
<th>Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>121 cows to 300 cows</td>
<td>-0.142</td>
<td>23.267*</td>
<td>0.044</td>
</tr>
<tr>
<td>301 cows to 500 cows</td>
<td>-0.704</td>
<td>27.543**</td>
<td>-1.185*</td>
</tr>
<tr>
<td>501 cows to 1,000 cows</td>
<td>0.578**</td>
<td>-</td>
<td>-2.235**</td>
</tr>
<tr>
<td>Off Farm Income</td>
<td>4.794**</td>
<td>13.097</td>
<td>0.078</td>
</tr>
</tbody>
</table>

Significance: * p<0.05, ** p<0.01
OFF-FARM INCOME INCREASES INEFFICIENCY FOR PRODUCERS SELLING CALVES

INCREASING HERD SIZE DECREASED INEFFICIENCY

PRODUCERS THAT SELL CALVES ARE LESS TECHNICALLY EFFICIENT THAN PRODUCERS SELLING FEEDERS

Results & Discussion Summary

<table>
<thead>
<tr>
<th>Group</th>
<th>Scale</th>
<th>Allocative</th>
<th>Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers Selling Calves</td>
<td>0.878</td>
<td>0.700</td>
<td>0.712</td>
</tr>
<tr>
<td>Producers Selling Feeders</td>
<td>0.876</td>
<td>0.710</td>
<td>0.754</td>
</tr>
<tr>
<td>Composite</td>
<td>0.877</td>
<td>0.705</td>
<td>0.731</td>
</tr>
</tbody>
</table>
PRODUCER CHARACTERISTICS
Identify other characteristics that may influence efficiencies (age, rented vs owned land, farm diversification).

PRODUCTION TECHNOLOGIES
Identify specific "technologies" that impact efficiencies (rotational grazing, AI, animal health).

FUTURE RESEARCH

UTILIZE ARMS DATA
Use DEA analysis on ARMS data to determine regional differences in production efficiency
THANK YOU

Questions, clarifications, and comments can be directed to heshear@ksu.edu.

Hannah E. Shear
Kansas State University
heshear@ksu.edu
www.hannahshear.com
@hannahshear

Dustin L. Pendell
Kansas State University
dpendell@ksu.edu

Richard Nehring
USDA - ERS
richard.nehring@usda.gov