Dynamic Effects of Drought on US Cow/Calf Producers

Amanda M. Leister*
John G. Lee**
Philipp L. Paarlberg**

Western Agricultural Economics Association
Annual Meeting: Monterey, California

June 26, 2013

*Colorado State University **Purdue University
Introduction

• Drought has been a severe challenge for U.S. crop and livestock producers

• The Southern Plains Region was hard hit initially by the drought in 2011

• Drought conditions in 2012 expanded throughout the central region of the country

• Nearly 80% of U.S. agricultural land experienced drought conditions during the summer of 2012

• Continued drought in 2012 exacerbated the initial drought impacts of 2011, and are expected to be felt for years to come (Wallander et al. 2013)

• Beef producer losses resulting from increased feed costs and decreased live cattle prices in 2011 and 2012
Prior Studies and Contribution

• Several studies assess short term economic implications of the 2011 or 2012 drought
  – Show significant short run regional economic losses to producers and consumers
  – Annual national study: Henderson (2012)

• Livestock sectors well represented by dynamic modeling frameworks
  – Dorfman and Lastrapes 1996, Gramig and Horan 2011

• This study considers long term adjustments to drought by both crop and livestock sectors over an extended time horizon

• Dynamic partial equilibrium quarterly modeling framework of the entire U.S. agricultural economy

• Estimates economic impacts of nationwide drought on livestock producers in 2011 and 2012
Theoretical Framework (1)

- Dynamic partial equilibrium model determines changes in prices and quantities relative to baseline values for U.S. livestock products, livestock, and crops in response to production shocks from drought conditions. (Paarlberg, et al. 2008, Paarlberg, et al. ERR 57)

- Model baseline includes quarterly values calculated from the annual USDA baseline and Livestock Marketing Information Center data using seasonal adjustments for 32 quarters

- Livestock and crop production adjust across time based on biological limitations

- Crop production by type occurs at set times of the year and then becomes carry-in stocks in subsequent quarters until a new crop is harvested

- Livestock are intermediate inputs into meat production
Theoretical Framework (2)

• Livestock tracked through the production system over time
   – Cattle, sheep, hogs, and lambs

• Breeding and replacement inventories determined by adjustments in salvage values and the expected relative profitability
   – Cow inventories adjust endogenously to changes in input prices and expected returns

• Cow/calf producers form expectations for future returns based on previous returns

• Declines in live cattle prices combined with rising feed costs causes cow/calf operators to reduce breeding cow inventories
   – Fewer calves and market cattle for slaughter several quarters later as cattle move through the production cycle

• Unique derived input demands for feed stock by livestock type and growth stage
   – Wheat, coarse grains, soybean meal, and forage and pasture
## Crop and Livestock Drought Shocks

### Quarterly Percentage Change Shocks by Commodity

<table>
<thead>
<tr>
<th>Year</th>
<th>Quarter</th>
<th>Winter Wheat</th>
<th>Spring Wheat</th>
<th>Winter Coarse Grains</th>
<th>Spring Coarse Grains</th>
<th>Rice</th>
<th>Soybeans</th>
<th>Winter Forage</th>
<th>Spring Forage</th>
<th>Finished Beef Cattle</th>
<th>Bkgd Beef Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>I</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>5.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-5.6</td>
<td>0</td>
<td>5.1</td>
<td>-4.9</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>0</td>
<td>-20.4</td>
<td>-0.6</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>-5.6</td>
<td>4.2</td>
<td>-3.1</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-7.0</td>
<td>0</td>
<td>-4.4</td>
<td>0</td>
<td>0</td>
<td>2.9</td>
<td>-0.7</td>
</tr>
<tr>
<td>2012</td>
<td>I</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-0.1</td>
<td>-0.6</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>-1.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-14.8</td>
<td>0</td>
<td>5.3</td>
<td>-6.5</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>0</td>
<td>21.7</td>
<td>-1.2</td>
<td>0</td>
<td>3.1</td>
<td>0</td>
<td>-14.8</td>
<td>2.4</td>
<td>-2.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>0</td>
<td>0</td>
<td>-25.7</td>
<td>0</td>
<td>-9.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.2</td>
<td>-1.3</td>
</tr>
</tbody>
</table>
Results: Coarse Grains and Forage

Changes in Coarse Grain and Forage Prices

- Coarse Grains
- Forage and Pasture

Quarter

$/mt

[Graph showing changes in coarse grain and forage prices over time]
Results: Steer Prices

Change in the Nebraska Steer Price

$/cwt

Quarter
Results: Cattle Slaughter

Change in Cattle Slaughter

Quarter

thd head

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

0 100 200 300 400 500

-500 -400 -300 -200 -100 0
Results: Cattle Breeding Inventory

Change in Beef Cattle Inventory

thd head

Quarters

Results: Cattle Breeding Inventory

Change in Beef Cattle Inventory

thd head

Quarters
Results: Welfare Impacts

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Processors</td>
<td>295</td>
<td>-99</td>
<td>-756</td>
<td>-1318</td>
<td>-1071</td>
<td>-565</td>
<td>-75</td>
<td>-153</td>
<td>-3743</td>
</tr>
<tr>
<td>Cow/Calf Producers</td>
<td>-1561</td>
<td>-4629</td>
<td>-4769</td>
<td>721</td>
<td>2307</td>
<td>1062</td>
<td>640</td>
<td>324</td>
<td>-5906</td>
</tr>
</tbody>
</table>
Conclusions

• Short term drought impacts:
  – Increased crop and forage prices
  – Decreased prices of live cattle cause by slaughter increases due to herd liquidation

• Long term impacts:
  – Crop prices remain above baseline levels
  – Declining animal breeding inventories due to reduced expected returns
  – Herd adjustment leads to fewer animals moving through the U.S. meat supply chain over time
  – Substantial losses in returns to processors and cow/calf producers

• Drought induced welfare losses:
  – Beef processor losses from reductions in slaughter and higher livestock prices
  – Cow/Calf producer losses from escalating feed costs and decreased U.S. beef cattle inventories
Thank You!