U.S. Ethanol Expansion: Overview of USDA’s Long-term Projections and Related Modeling Issues

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Presentation Overview

• USDA long-term agricultural projections to 2016

• Highlights of projections
  – Ethanol expansion
  – Crop adjustments
  – Livestock adjustments
  – Potential market variability
  – Retail food price projections

• Focus on distillers grains
  – Modeling and data issues
  – Corn and soybean meal feed use substitutions
  – Livestock sector uses

• Other ethanol-related issues
Acknowledgments

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• Nick Bradley, USDA/ERS & University of West Virginia
U.S. ethanol expansion
Ethanol’s role in gasoline and corn markets: An asymmetric relationship

Ethanol is small relative to overall gasoline use

- Ethanol: 3.5%
- Gasoline: 96.5%

2006

But ethanol accounts for a large and growing share of corn use

- Ethanol: 14%
- FSI less ethanol: 12%
- Exports: 19%
- Feed and residual: 55%

2005/06

Stock-to-use ratio, 17.5%
Policy component important for 2006 Baseline: Renewable fuels program & corn-based ethanol production

- Renewable fuels program, Energy Policy Act of 2005
- Corn-based ethanol production, 2005 USDA Baseline
- Corn-based ethanol production, 2006 USDA Baseline

Billion gallons

Crop year

2000/01 2005/06 2010/11 2015/16
U.S. ethanol capacity growing rapidly
Corn-based ethanol production projections exceed renewable fuels program mandate

2007 USDA projections

2006 USDA Baseline

Renewable fuels program, Energy Policy Act of 2005
Ethanol’s role in gasoline and corn markets: Projected relationships in 10 years

Ethanol still small relative to overall gasoline use

- Ethanol: 7.5%
- Gasoline: 92.5%

2017

Ethanol accounts for over 30% of corn use

- Ethanol: 31%
- Feed and residual: 42%
- Other FSI: 11%
- Exports: 16%

Stock-to-use ratio, 5.7%

2016/17
Crop comparisons
Corn use projections, ethanol production
Larger front end expansion in 2007 projections
Crop sector effects of ethanol expansion

• Corn
  – Higher prices
  – Reduced exports and domestic use
  – Lower stocks
  – Increased acreage

• Soybeans
  – Lower acreage for competing crops, particularly soybeans
  – Reduced exports, domestic use, and stocks
  – Higher prices
Corn use projections, exports

2005 USDA Baseline
2006 USDA Baseline
2007 USDA projections

Crop year

Billion bushels
Corn projections, feed use*

* Includes statistical “residual”
Corn projections, ending stocks

Billion bushels

Crop year

2000/01 2005/06 2010/11 2015/16

2005 USDA Baseline
2006 USDA Baseline
2007 USDA projections
Corn price projections

$/bushel

Crop year

2005 USDA Baseline

2006 USDA Baseline

2007 USDA projections
Corn projections, planted area

Million acres

Crop year

- 2005 USDA Baseline
- 2006 USDA Baseline
- 2007 USDA projections

- 2000/01
- 2005/06
- 2010/11
- 2015/16
Soybean projections, planted area
Part of corn area expansion comes from soybeans
Soybean price projections

2005 USDA Baseline
2006 USDA Baseline
2007 USDA projections

Crop year
Attempt to extract soybean price projections from the image and convert it into plain text.
Soybean use projections, exports
Soybean oil, domestic use

- 2000/01
- 2005/06
- 2010/11
- 2015/16

Billion pounds

- U.S. biodiesel expansion
- 2005 USDA Baseline
- 2006 USDA Baseline
- 2007 USDA projections
Soybean oil price projections

Crop year

$/pound

2005 USDA Baseline
2006 USDA Baseline
2007 USDA projections
2005 USDA Baseline
Livestock comparisons
Livestock sector effects of ethanol expansion

• Higher corn prices
• Greater availability of ethanol production coproducts
  – Distillers grains from dry mill ethanol production
• Different effects across livestock types
• Lower production for all meats
Beef production

2006 USDA Baseline

2007 USDA projections
Pork production

2006 USDA Baseline

2007 USDA projections

Billion pounds

Year

Potential market volatility
Potential market volatility

- Corn demand for ethanol production is inelastic
- Growing share of demand for corn is more inelastic
- Vulnerability to corn production shortfalls with increasingly inelastic demands
  - Near-term--relatively high beginning corn stocks have helped in 2006/07
  - Longer-term--lower corn stocks provide less buffer
- Stocks are also low for wheat and soybeans
Stocks-to-use ratios: Corn, wheat, and soybeans
Retail food prices
Distillers grains: Livestock sector uses and implications for feed use of corn and soybean meal
Distillers grains use questions

• How does use of distillers grains affect direct corn feed use and soybean meal use?
  – How much of distillers grains go to livestock vs. exports and other uses???
  – How much go to each livestock sector??
  – How much of the ration for the different livestock sectors can be replaced by distillers grains??
  – What are the substitutions of distillers grains for corn and soybean meal in rations??

• What are the implications for livestock feed costs?
Distillers grains information

• 17.5 pounds of distillers grains from 56 pound bushel of corn (roughly a third)
• Our focus is on how distillers grains are used in rations for their energy and protein content (relative to corn and soybean meal)
• However, other nutrients in distillers grains are about 3 times the concentration as in corn
• Use of distillers grains for energy and/or protein means rebalancing ration for those other nutrients
• Favors use by ruminants relative to monogastric animals
Distillers grains/livestock references


Distillers grains uses:
Allocation assumptions

- 75% to livestock
- 10% exported
- 15% other
Distillers grains livestock uses: Allocation assumptions

- 80% to beef cattle
- 10% dairy
- 5% hogs
- 5% poultry
## Grain Consuming Animal Units, 2005/06 feed year

<table>
<thead>
<tr>
<th>Animal type</th>
<th>GCAU weights</th>
<th>Head</th>
<th>2005/06 GCAUs</th>
<th>GCAU Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1,000 Million units</td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td><strong>Cattle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cows</td>
<td>1.0475</td>
<td>9,063</td>
<td>9.493</td>
<td>10</td>
</tr>
<tr>
<td>Heifers</td>
<td>0.1761</td>
<td>4,275</td>
<td>0.753</td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle on feed</td>
<td>1.5323</td>
<td>14,132</td>
<td>21.654</td>
<td>24</td>
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<tr>
<td>Other</td>
<td>0.0547</td>
<td>69,232</td>
<td>3.787</td>
<td></td>
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<tr>
<td><strong>Hogs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.2285</td>
<td>104,615</td>
<td>23.904</td>
<td>26</td>
</tr>
<tr>
<td><strong>Poultry</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layers</td>
<td>0.0217</td>
<td>345,338</td>
<td>7.494</td>
<td>8</td>
</tr>
<tr>
<td>Broilers *</td>
<td>0.0020</td>
<td>9,087,000</td>
<td>18.066</td>
<td>20</td>
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<tr>
<td>Pullets</td>
<td>0.0054</td>
<td>298,783</td>
<td>1.613</td>
<td></td>
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<tr>
<td>Turkeys *</td>
<td>0.0155</td>
<td>264,874</td>
<td>4.072</td>
<td>4</td>
</tr>
<tr>
<td><strong>Sheep</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0194</td>
<td>6,230</td>
<td>0.121</td>
<td></td>
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<tr>
<td><strong>Horses and mules</strong></td>
<td>0.2043</td>
<td>2,539</td>
<td>0.519</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>91.477</td>
<td></td>
</tr>
</tbody>
</table>

* GCAUs for broilers and turkeys reflect weighted averages of current and lagged head numbers.

Updated February 2007.
Distillers grains livestock uses:
Maximum ration inclusion recommendations

• Beef cattle 40%*
• Dairy 20-25%
• Hogs 20%, growing, finishing, gilt development
• Poultry 15%, grower, finisher
Distillers grains livestock uses:
Ration substitutions for corn & soybean meal

- Beef cattle—100% corn; (protein source, urea)
- Dairy—45% corn; 55% soybean meal
- Hogs—85% corn; 15% soybean meal
- Poultry—55% corn; 45% soybean meal
Distillers grains livestock uses:
Adding up for corn substitution

Distillers grains-corn substitution
• 0.75 to livestock *

\[(0.80 \text{ beef cattle } @ 100\% \text{ corn substitution}) + (0.10 \text{ dairy } @ 45\% \text{ corn substitution}) + (0.05 \text{ hogs } @ 85\% \text{ corn substitution}) + (0.05 \text{ poultry } @ 55\% \text{ corn substitution})] = 0.686

• 0.686 * 17.5 pounds distillers grains = 12 pounds
• 12 pounds/56 pound bushel = 21 percent (21 percent of corn bushel used for ethanol replaces corn feed use)
Distillers grains livestock uses:
Adding up for soybean meal substitution

Distillers grains-soybean meal substitution

• Since most distillers grains use in beef cattle rations, soybean meal substitution much less
• About 1.1 pounds soybean meal replaced in livestock rations for each 56 pound bushel of corn used for ethanol production
Distillers grains livestock uses:
Adding up, other implications

Overall substitution of distillers grains in livestock rations
- 91.5 percent for corn
- 8.5 percent for soybean meal
Beef cattle feed cost adjustments with distillers grains

• Feed cost in model is based on corn price and soybean meal prices (proxy for urea)

• Derive a new “corn price”
  – Blend of the actual corn price and a discounted “corn-equivalent” of distillers grains price
  – Weighted average reflects market penetration
  – Discount of distillers grain price reflects market penetration

• Also lower cost to account for urea reduction

• Longer-term question—Will distillers grains be priced at a deeper discount?
Prices for corn and distillers grains

Index, 2000 = 100

Corn

Distillers grains, Lawrenceburg, IN

http://www.ers.usda.gov/data/feedgrains/
Other ethanol issues
Other ethanol issues

- Economics of ethanol production
  - Ethanol pricing
  - Distillers grains pricing
- Corn/ethanol conversion factor
- Distillers grains variability
- Infrastructure issue
  - Shipment and storage of corn, ethanol, and distillers grains
  - Vehicle fleet
- Government costs
- Water needs
- Environmental effects
- Cellulosic potential in the longer run
Ethanol and gasoline rack prices, Nebraska

http://www.neo.state.ne.us/statshtml/66.html
Prices for corn and distillers grains

http://www.ers.usda.gov/data/feedgrains/
## Corn/ethanol conversion factor:
Gallons of ethanol per bushel of corn

<table>
<thead>
<tr>
<th></th>
<th>70% starch</th>
<th>73% starch</th>
<th>75% starch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn bushel, lbs.</td>
<td>56</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Moisture content</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Corn bushel, lbs., DM</td>
<td>47.6</td>
<td>47.6</td>
<td>47.6</td>
</tr>
<tr>
<td>Starch content, percent</td>
<td><strong>70</strong></td>
<td><strong>73</strong></td>
<td><strong>75</strong></td>
</tr>
<tr>
<td>Starch content, lbs.</td>
<td>33.320</td>
<td>34.748</td>
<td>35.700</td>
</tr>
<tr>
<td>Starch to glucose conversion factor</td>
<td>1.07</td>
<td>1.07</td>
<td>1.07</td>
</tr>
<tr>
<td>Glucose content, lbs.</td>
<td>35.652</td>
<td>37.180</td>
<td>38.199</td>
</tr>
<tr>
<td>Ethanol share</td>
<td>0.51</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>CO2 share</td>
<td>0.49</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td>Ethanol, lbs.</td>
<td>18.183</td>
<td>18.962</td>
<td>19.481</td>
</tr>
<tr>
<td>CO2, lbs.</td>
<td>17.470</td>
<td>18.218</td>
<td>18.718</td>
</tr>
<tr>
<td>Ethanol, lbs per gallon</td>
<td>6.59</td>
<td>6.59</td>
<td>6.59</td>
</tr>
<tr>
<td>Ethanol, gallons</td>
<td>2.76</td>
<td>2.88</td>
<td>2.96</td>
</tr>
</tbody>
</table>
Distillers grains variability

• Variability of distillers grains increases the challenge of the livestock sector to use as a feed

• On the supply side, distillers grains considered an economic “by-product” by ethanol producers, since ethanol production has been so profitable

• Once ethanol margins narrow, ethanol producers will have more economic incentive to pay attention to distillers grains as an economic “coproduct”

• Suggests adjustments in production processes that reduce the variability of distillers grains

• On the use side, there is variability in other feeds, such as corn, but the livestock sector is used to dealing with that variability

• Distillers grains are new, so the livestock sector will learn how to manage some of the variability
Government costs

• Lower farm commodity program costs for price-sensitive programs
  – Marketing loans
  – Counter-cyclical payments
• Higher Conservation Reserve Program costs
  – Higher CRP rental rates
• Reduced tax revenues
  – Higher biofuel blender tax credits