Modeling the National Beef Supply Chain
Leading a multi-institutional, interdisciplinary collaboration
Elaine Hill and Nicole Tichenor
Where we’re headed

• Larger project overview
• Formative research
• Team Beef
• Model
• Challenges
• Next steps
The EFNSE Project

• Enhancing Food Security in the Northeast through Sustainable Regional Food Systems
• 5 year NIFA-AFRI grant
• Teams
  – CONS – EDUC
  – DIST – OUTR
  – PROD – SCHEMO
EFSNE Project Sites and Collaborating Institutions

- Rural Study Sites (DE, NY and VT)
- Metro Study Sites

Sites:
- Charleston
- Baltimore
- Syracuse
- Pittsburgh
- Philadelphia
- New York
- Charleston
- USDA
- Penn State
- Columbia University
- NESAWG
- Tufts
- USDA
Market Basket Approach

- Low-income consumption and regional availability
Connecting PROD and DIST

- Identify production centers for market basket commodities
- Beef is special...
...in many ways
Enter Team Beef

- Elaine Hill and Miguel Gomez
- Nicole Tichenor and Tim Griffin

- Leveraging disciplinary expertise of DIST and PROD teams
Team Objectives

• Year 3
  – Literature review
  – Cross-project dialogue about model flexibility and linkages
  – Compile data
  – Begin model development

• Year 4
  – Finish model
  – Prepare manuscript
How We Operate

• Conference calls
  – Duo
  – Team Beef
  – Greater project team
• Modeling and writing “retreats”
• Assistance from other Tufts and Cornell students
• Dropbox
Methods

• Building supply chain optimization model
  – National scale, county-level resolution
  – Objective function minimizes costs
  – Excel, Stata and GAMS
  – Differentiated products

• Running baseline and scenario simulations
  – GAMS
Datasets

• Supply and sales of cattle
  – USDA NASS
• Slaughter
  – USDA NASS, USDA APHIS, CBP, publicly-available data from firms
• Imports/Exports/Storage
  – USDA ERS
• Demand
  – USDA ERS, American Meat Institute
Starter Model

- Export locations
- Slaughter quantities (by state)
- Import quantities
- Slaughter locations
- Import locations
- Demand locations
- Storage
- Demand quantities (per capita)
Expanded Model

- Dairy and beef cows
- Beef steers and heifers; Dairy steers
- Feedlot locations
- Export locations
- Slaughter locations
- Demand locations
- Import locations
- Storage

Retail cuts demand/capita
Ground beef demand/capita
Import quantities
Data Flow

National 2007 slaughter by cattle class (head)

All dairy cows

All beef cows

Steers

% on feed as dairy steers

% on feed as beef steers

Heifers

100% on feed as beef heifers

Proportion of slaughter from dairy farms

Proportion of slaughter from cow calf farms

County level dairy cow inventories

County level beef cow inventories

Cattle on Feed, Sales for Slaughter (county)

Conversion: calf to cattle weights

Conversion: head --> live weight --> carcass weight

Cutouts for all 5 classes/breeds

Slaughter (county; small vs. large facilities)

Demand (lbs) for GB and RC by location

Notes: Bulls omitted. All fed heifers are beef heifers.
Supply Nodes

Nicholson et al. 2010
Demand Nodes

Nicholson et al. 2010
Example Output

Fluid Milk Shadow Price, Scenario 5, May 2006 Data

USDSS Localization Project Model Run 10/22/12.
Scenario Analysis

• Increasing supply from dairy operations
  – Greek yogurt
  – Climate change
• Changing seasonality of calving
• Slaughter vs. fuel efficiency
• Expanding capacity of slaughter and processing in the Northeast
Building a model from scratch

- How would you start?
- Defined demand by population centers
  - Per capita beef consumption * county level population
- Supply
  - No origins for slaughtered cattle
  - Calculate county proportions from inventory data and assign national slaughter by cattle class to county
Building a model from scratch

• How do you convert head to lbs?
• Head $\rightarrow$ live weight at slaughter $\rightarrow$ carcass weight $\rightarrow$ retail cuts + GB + inedible
  – For 5 breeds/classes...
Other Challenges

- Integrating supply from dairy
- Culling vs. feeding
- Multi-product supply chain
- Slaughter and economies of scale
- Transport costs
- Balancing
- Seasonality
- Production cycles
Going Forward

• Finishing expanded model
• Adding precision
  – Consumption, costs, slaughter capacity
• Drafting baseline manuscript
• Conducting scenario analyses
Figure 1
Production-cycle timelines for grass-finished versus conventional grain-fed beef production

Calf-fed: Calf weaned, placed in feedlot

(Short) Yearling: Calf weaned, pasture, feedlot

(Long) Yearling: Calf weaned, pasture, feedlot

Grass-finished: Calf weaned, grown, and finished on pasture


Source: Mathews and Johnson, 2013.