What Does Dairy Trade Modeling Tell Us?  
(About Important Dairy Globalization Issues)

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Outline of the Presentation

• What are key issues and events in dairy globalization?  
• How can modeling provide insights?  
• What are the challenges (to dynamic modeling of dairy globalization)?
Defining Dairy Globalization

Flows of:
- Dairy products (farm milk)
- Funds
  - Direct investments in production, processing, logistics, promotion
- Information
  - Technology, market intelligence, experience
- Relationship development
  - Partnerships, supply chain coordination

Scope of Dairy Globalization

Drivers:
- Demand growth
  - Income growth, urbanization, food service, policy
- Supply side
  - Milk production growth, export market experience, promotion investments, logistics/infrastructure development
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**Effects:**
- Price convergence
  - Global price discovery
  - Product, farm milk?
- Environmental
  - Land use, GHG emissions, human health
- Other Economic
  - Employment, welfare

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Dairy Globalization, 2006-2016

**What Hath 10 Years Wrought?**

- Price convergence in global dairy markets
  - Increased volatility
  - Cyclical behavior
- Emergence of China as key importer
- Emergence of US as key, consistent exporter
- Phase out of EU production quotas

Price convergence in WMP markets, after 2006
Percentage Changes in Global Exports, 2006-2016

% Changes in Export Volumes, 2003-2013

Source: PSD Data, USDA/FAS
Source: FAO database.

$26 billion to $71 billion total value
Export Market Shares, 2006 and 2016

Source: PSD Data, USDA/FAS
Export Market Shares, 2006 and 2016

Source: PSD Data, USDA/FAS

Import Market Shares, 2006 and 2016

Source: PSD Data, USDA/FAS
Import Market Shares, 2006 and 2016

**WMP**

- **2006**
  - China: 45%
  - Mexico: 20%
  - Russia: 10%
  - Algeria: 5%
  - Venezuela: 5%
  - Other: 5%

- **2016**
  - China: 40%
  - Mexico: 25%
  - Russia: 20%
  - Algeria: 10%
  - Venezuela: 5%
  - Other: 5%

**Fluid Milk**

- **2006**
  - China: 60%
  - Mexico: 20%
  - Russia: 10%
  - Botswana: 5%
  - Canada: 5%
  - Other: 5%

- **2016**
  - China: 55%
  - Mexico: 25%
  - Russia: 20%
  - Botswana: 10%
  - Canada: 5%
  - Other: 5%

Source: PSD Data, USDA/FAS

Import Market Shares, 2006 and 2016

**NDM/SMP**

- **2006**
  - China: 40%
  - Mexico: 20%
  - Russia: 10%
  - Indonesia: 10%
  - Philippines: 10%
  - Other: 10%

- **2016**
  - China: 45%
  - Mexico: 25%
  - Russia: 20%
  - Indonesia: 15%
  - Philippines: 10%
  - Other: 5%

Source: PSD Data, USDA/FAS
Butter Markets Show Less Integration

- Butter price spreads larger than for other products
  - Recent changes in the relationship
- Butter more protected by trade policy than other products
- Cause of recent farm milk price divergence?

Farm Milk Price Divergence Re-Emerges, 2014 to ?

- US Prices Higher
- US Prices Lower
Potential Trade Agreements

- Previously, TPP
- Tenuously, TTIP
- Many bilateral agreements?
- NAFTA, revisited?

What are the implications for US dairy market outcomes?

Potential Trade Disputes

- Look north of the US border
Dairy Globalization is Multi-faceted

- Many structural changes
  - EU production quota phase out
- Many short-term events
  - China in and out of butter markets, 2014
  - (Ongoing) Russian trade embargo
- Many proposed modifications to trading relationships
- Many (potential) trade and globalization conflicts

What Can Models Tell Us?

- Explain past developments
- Predict ranges of future outcomes
Current Modeling Approaches*

* Academic models. Other commercial and proprietary models exist.

- GTAP
  - General equilibrium model
  - Limited commodity coverage
- FAPRI-MU International Dairy Model
  - Partial equilibrium dynamic model
- Virginia Tech – Center for Agricultural Trade
  - Mixed complementarity formulation
  - Partial equilibrium

Dairy Globalization Modeling Insights Modeling Challenges

US TPP Impact Analysis
(Through indicated year)

$ million Change due to TPP

TPP Price Impact Analysis
(FAPRI-MU IDM)


What Can Models Tell Us?

• Explain past developments
• Predict ranges of future outcomes
• Organize existing knowledge base
  – Data and behavioral assumptions
• Assess the importance of information
  – Not all information has equal value
• Allow hypothesis testing
  – Are our assumptions about the world really correct?
The Need for a Dynamic Model

- Many phenomena related to globalization are dynamic—they play out over time
- Feedback effects are not well captured in existing partial equilibrium models
  - Even the dynamic ones
  - Or (dynamic) CGE models
- Dynamic complexity: short and long-run effects can differ

The Need for Detailed Product and Component Coverage

- Trade depends on product specifications
- Trade policies also very product-specific
- Products are linked as joint products, as intermediate products and as substitutes in production or in use
Dynamic Global Dairy Supply Chain Model (DGDSCM)

- Production, processing, demand and trade for 15 world regions
  - Complete global coverage
- Monthly evolution of prices and trade flows
- Assessment of past and future scenarios

Model Characteristics:
- 15 regions
- 23 final and intermediate products
- Component balance for milk and product yields
- Supply-chain-based business decisions
- “Dynamic disequilibrium”

Regional Designations
- US (CA)
- Mexico
- Canada
- MENA
- EU
- Russia
- FSU
- China
- Oceania
- Major South America
- Other Net Exporters
- Other Net Importers
- ASEAN

Dairy Globalization Insights Challenges
DGDSM Products

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Final Product</th>
<th>Intermediate Product</th>
<th>Tradable Product</th>
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<tbody>
<tr>
<td>Fluid Milk</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Yogurt</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Frozen Desserts</td>
<td>X</td>
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<tr>
<td>Cottage Cheese</td>
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<tr>
<td>American-type Cheeses</td>
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<td>X</td>
<td></td>
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<tr>
<td>Other Cheeses</td>
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<tr>
<td>Fluid Whey</td>
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<td></td>
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<tr>
<td>Separated Whey</td>
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<tr>
<td>Whey Cream</td>
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<tr>
<td>Dry Whey</td>
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<td>X</td>
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<tr>
<td>Whey Protein Concentrate 34% Protein</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>Whey Protein Concentrate 80% Protein</td>
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<tr>
<td>Lactose</td>
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<td>Butter</td>
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<tr>
<td>Nonfat Dry Milk</td>
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<td>Infant Formula</td>
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<tr>
<td>Condensed Skim Milk</td>
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<td>X</td>
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<tr>
<td>Other Evaporated, Condensed &amp; Dry products</td>
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<tr>
<td>Casein</td>
<td>X</td>
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<tr>
<td>Caseinates</td>
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<td>X</td>
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<tr>
<td>MPC, &lt; 50% protein</td>
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<tr>
<td>MPC, &gt;= 50% protein</td>
<td>X</td>
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</tr>
</tbody>
</table>

DGDSM Dynamics

Farm Level:
- Profitability and expectations drive cow numbers and milk per cow
- Asymmetric response to profitability changes
  - Less responsive to downturns
- Milk price derived from product prices

Processing Sector:
- Production volumes driven by profitability and demand
  - NDM and butter are residual products
- Price-setting based on inventory coverage
  - Product stocks
DGDSCM Dynamics

**Product Demand:**
- Base levels of final use “commercial disappearance”
- Final demand based on assumed annual growth rates and prices
- Intermediate product demand endogenously determined
  - Costs of selected feasible combinations

**Trade Flows:**
- Based on previously observed levels
- Changes driven by changes in relative landed prices
  - Including transportation costs and exchange rate factors
- Base levels updated over time by recent experience
  - “Anchoring and adjustment”

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We Assess Globalization with Limited, Inconsistent Data

- Inventory data lacking for price discovery
- S&U data often lack consistency
  - Especially for component balance
- Import and Export totals differ
- Trade policy database not generally available

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Dairy Globalization Modeling Insights Modeling Challenges
Example of Data Inconsistency:
All Cheese, Canada, 2013

Note: All of the values differ for the three sources!

Production
Imports
Exports
Balance

PSD
FAO
Statistics Canada

Note: All of the values differ for the three sources!

Major Effort for Data for Dynamic Model

- Multiple inconsistent sources
- Incomplete sources
- Aggregation
  - Trade policies differ within regions
- Model calibration and evaluation

“Blood, toil, tears and sweat...”
-- Churchill (and Stephenson)
Other (Omitted) Factors

Factors other than (landed) price determine dairy trade flows--now and later

- Working relationships, trust, reputation, joint ventures
- Product characteristics not captured in trade data
- Flows of information and funds (investment) will alter the dairy trade landscape

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Coming This Summer to Prime Time

Dynamic Global Dairy Supply Chain Model