A Modeling Framework for Evaluating Economic Impacts of APHIS Import Regulations

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Presented at USDA/APHIS Policy Analysis and Development
September 27, 2012
Outline

• Economics in Regulatory Decision Making

• Model Framework

• Fitting the Model to An Empirical Study: Case of the U.S. Beef Market
Economics in Regulatory Decisions

• Why does economics enter into USDA regulatory decisions by APHIS and other agencies?
  • Assessment of benefits and costs
  • International commitments and obligations
  • The political process
The APHIS/PAD-VT Project

- Origins in the avocado case, mid 1990s-2007
- Key part of a multi-dimensional VT effort with USDA (APHIS, CREES, ERS, NIFA)
- Development of an economic simulation model as a tool to support regulatory decision making
- Applications for model development, training and \textit{ex-ante} impact assessment (prior to specific regulatory processes)
  - Poultry, apples, citrus, beef
General Model Framework

• Applicable to diverse regulatory options
  • New market access
  • Origin, destination or seasonal restrictions
  • Systems approaches and other compliance requirements

• Incorporate different market situations
  • Model demand and supply in key countries/regions
    • Single exporter, 2 importers (US, ROW)
    • Multiple exporters, 2 importers
    • Multiple exporters and importers (world market)
General Framework: Continued

• Incorporate cost of compliance
  • Could affect supply of exporter facing regulatory change

• Could incorporate pest risk
  • If zero pest risk, not needed
  • If risk information available, it can be incorporated
    • Peterson and Orden (*American Journal of Agricultural Economics*) show the importance of maintaining a systems approach for avocados after removal of seasonal and geographic restrictions
Illustration of General Framework

• 4 different countries/regions

• Two demand regions
  • Region 1 (US) implementing regulatory change
  • Region 2 (e.g., ROW) not changing policy

• Two net exporters
  • Region 3: Exporter deemed free of pest or pathogen
  • Region 4: Exporter facing regulatory change in 1
Demand in Regions 1 and 2

- Derived from
  - Utility function for representative consumer
  - Allows for possible product differentiation

- General notation:

\[ Q_{ij}^D = D_{ij}(p_{1j}, p_{2j}, p_{3j}, p_{4j}); \quad \forall i = 1, \ldots, 4 \text{ and } j = 1(US), 2(ROW) \]

- Own-price effects are negative
- All varieties are substitutes
Supply in Regions 1 and 2

- General notation:

\[
US : Q_{1j}^S = S_{1j}(p_{11} - m_{11}, p_{12} - m_{12}) \quad j = 1(US), 2(ROW)
\]

\[
ROW : Q_{2j}^S = S_{2j}(p_{21} - m_{21}, p_{22} - m_{22}) \quad j = 1(US), 2(ROW)
\]

- Own-price effects are positive
- Cross-price effects are negative – substitution between markets
- Could incorporate pest risk for Region 1
Net Export Supply Functions

• Region 3:

\[ Q_{3j}^S = ES_{3j} \left( p_{31} - m_{31}, p_{32} - m_{32} \right) j = 1(US), 2(ROW) \]

  • Use excess supply functions

• Region 4:

\[ Q_{4j}^S = ES_{4j} \left( p_{41} - m_{41}, p_{42} - m_{42}, CC_{4j} \right) j = 1(US), 2(ROW) \]

  • Cost of compliance (CC) has negative effect on export supply
Market Clearing Conditions

• Because of assumption of differentiated products:

\[ Q^D_{ij} = Q^S_{ij} \quad \forall i, j \]

• Endogenous variables:

\[ Q^D_{ij}, Q^S_{ij}, p_1, p_2, p_3, p_4 \]

• Exogenous variables:

\[ CC_{4j}, m_1, m_2, m_3, \text{and } m_4 \]

• Other economic variables held constant
Data Requirements

• Quantity of each variety consumed in each demand region

• Price paid for each variety in each demand region

• Net prices received by producers in each supply region

• Estimate of compliance costs (when available)
Model Implementation

• Need a specific functional form for each demand and supply function

• Key parameters: demand and supply elasticities

• Choice of functional form
  • Prefer functions that are parsimonious in number of parameters
  • Common choices for supply and demand
Problem with CES Demand Function

- Demand function will never equal zero (e.g. intersect axis) if price is finite
Why is This Important?

• May need to assess the impact of replacing an import ban with a different regulatory option

• Quantity consumed from supply region facing a ban initially would equal zero in the demand region imposing the ban

• Problem with CES:
  • Cannot move from zero consumption initially to positive consumption after removal of ban without making ad hoc changes to parameters of the utility function
Solution?

• Trans-log expenditure function:

\[
\ln e_j(p) = \alpha_{0j} + \sum_{i=1}^{N_T} \alpha_{ij} \ln p_{ij} + \frac{1}{2} \sum_{i=1}^{N_T} \sum_{k=1}^{N_T} \gamma_{ikj} \ln p_{ij} \ln p_{kj}
\]

• Demand function for variety \( i \) in demand region \( j \):

\[
s_{ij} = \alpha_{ij} + \sum_{k=1}^{N_T} \gamma_{ikj} \ln p_{kj}
\]

• Reservation price
Implementing Trans-log

• How to deal with large number of parameters?

• Bergin and Feenstra
  • All cross-price effects are equal \( \gamma_{ikj} = \gamma_j \)
  • Same as CES utility function

• Choosing parameters if all varieties available
  • \( \gamma_j \) chosen to replicate one own-price demand elasticity
  • \( \alpha_{ij} \) chosen to match observed budget shares
  • \( \alpha_{0j} \) chosen to match observed expenditure on all goods
What if All Varieties Not Available?

• Will need to determine value of reservation price for unavailable variety

• Consider two available and one unavailable varieties:

\[ s_1 = \alpha_1 - 2\gamma \ln p_1 + \gamma \ln p_2 + \gamma \ln p_3 \]
\[ s_2 = \alpha_2 + \gamma \ln p_1 - 2\gamma \ln p_2 + \gamma \ln p_3 \]
\[ 0 = \alpha_3 + \gamma \ln p_1 + \gamma \ln p_2 - 2\gamma \ln p_3 \]

• Imposing linear homogeneity: \( \alpha_3 = 1 - \alpha_1 - \alpha_2 \)

• 3 equations in 3 unknowns, but no unique solution
Solution to Indeterminacy?

• Indentify available variety that would be close substitute in demand with unavailable variety
  • Countries in close proximity?

• Assumption
  • Reservation price for unavailable variety is equal to a similar available variety

• If reservation price exceeds forecasted post-entry price for variety that is initially unavailable, entry will occur
Case Study of the U.S. Beef Market

U.S. Beef Production, Exports and Imports
## U.S. Beef Model Database (fresh beef)

<table>
<thead>
<tr>
<th>HS-6</th>
<th>Description</th>
<th>U.S. import share, % ave. 2006-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>020110</td>
<td>Bovine Carcasses And Half Carcasses, Fresh Or Chilled</td>
<td>0.45</td>
</tr>
<tr>
<td>020120</td>
<td>Bovine Cuts Bone, Fresh Or Chilled</td>
<td>3.97</td>
</tr>
<tr>
<td>020130</td>
<td>Bovine Cuts Boneless, Fresh Or Chilled</td>
<td>36.24</td>
</tr>
<tr>
<td>020210</td>
<td>Bovine Carcasses And Half Carcasses, Frozen</td>
<td>0.03</td>
</tr>
<tr>
<td>020220</td>
<td>Bovine Cuts Bone, Frozen</td>
<td>0.47</td>
</tr>
<tr>
<td>020230</td>
<td>Bovine Cuts Boneless, Frozen</td>
<td>58.84</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Sources of U.S. Fresh Beef Imports, ave. 2006-2010 (mil kg)
Fresh Beef Exports, ave. 2006-2010 (mil kg)
U.S. Production of Cuts and Ground Beef, ave. 2006-2010 (%)

“National Comprehensive Boxed Beef Cut” of USDA/AMS contains weekly data on U.S. beef production of the following types: Prime, Branded, Choice, Select and Ungraded (grinds and trims)
USDA/AMS also publishes weekly data on beef imports from various countries in the following categories: Ground, Miscellaneous fresh, Manufacturing (beef trimmings for processing), Cuts, Head/Check meat and Edible Organs.
Structure of the U.S. Beef Simulation Model

- Import suppliers
- Rest of the world
- U.S. beef producer
- Exports
- Domestic
- U.S. ground beef processor
- Cuts
- Ground
- Beef
- U.S. consumer
- Others
Recent Regulatory Assessments on South American Beef

- **Brazil**
  - In 2007, OIE declared Santa Catarina as FMD-free without vaccination (2% of Brazilian beef production)
  - In 2010, USDA/APHIS risk evaluation indicated the state as FMD-free

- **Argentina**
  - In 2007, USDA/APHIS proposed to recognize the province of Patagonia as FMD-free without vaccination (2% of Argentinean beef production)

- To date there have not been any regulatory changes proposed to allow imports of beef from Brazil or Argentina into the U.S.

- On August 30, 2012 Argentina requested WTO dispute settlement consultations on the U.S. import restrictions for beef meat and other products of animal origin
## Baseline Wholesale and Producer Prices, ($/kg)

<table>
<thead>
<tr>
<th></th>
<th>Wholesale price</th>
<th>Producer price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite price in U.S.</td>
<td>5.08</td>
<td></td>
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<tr>
<td>Beef cuts</td>
<td>5.38</td>
<td></td>
</tr>
<tr>
<td>Ground Beef</td>
<td>4.71</td>
<td></td>
</tr>
<tr>
<td>Beef Cuts</td>
<td>5.38</td>
<td></td>
</tr>
<tr>
<td>U.S. Produced</td>
<td>5.47</td>
<td>4.48</td>
</tr>
<tr>
<td>Imports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>3.31</td>
<td>3.20</td>
</tr>
<tr>
<td>Australia</td>
<td>3.97</td>
<td>2.90</td>
</tr>
<tr>
<td>New Zealand</td>
<td>3.63</td>
<td>2.33</td>
</tr>
<tr>
<td>Uruguay</td>
<td>3.30</td>
<td>2.10</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>3.31</td>
<td>2.60</td>
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<tr>
<td>Mexico</td>
<td>5.65</td>
<td>2.75</td>
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<tr>
<td>Others</td>
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<td>2.14</td>
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<tr>
<td>Brazil</td>
<td>-</td>
<td>1.95</td>
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<tr>
<td>Argentina</td>
<td>-</td>
<td>1.87</td>
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<tr>
<td>For beef processing</td>
<td>4.56</td>
<td></td>
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<tr>
<td>U.S. Produced</td>
<td>4.80</td>
<td>3.96</td>
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<tr>
<td>Imports</td>
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<tr>
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<tr>
<td>Australia</td>
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<tr>
<td>New Zealand</td>
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<td>2.06</td>
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<td>Uruguay</td>
<td>2.88</td>
<td>1.85</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>2.90</td>
<td>2.29</td>
</tr>
<tr>
<td>Mexico</td>
<td>4.89</td>
<td>2.43</td>
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<tr>
<td>Others</td>
<td>3.07</td>
<td>1.98</td>
</tr>
<tr>
<td>Brazil</td>
<td>-</td>
<td>1.72</td>
</tr>
<tr>
<td>Argentina</td>
<td>-</td>
<td>1.65</td>
</tr>
</tbody>
</table>
Estimated Entry and Reservation Prices of Brazilian and Argentinean Beef, $/kg

**Brazilian beef estimated and reservation prices, $/kg**

- Beef cuts
- Ground beef

**Argentinean beef estimated and reservation prices, $/kg**

- Beef cuts
- Ground beef
U.S. Beef Tariff Rate Quotas (TRQs)

- In-quota tariff rate: 4.4 cents/kg
- Out-of-quota tariff rate: 26.4%
- Quota limits on non-NAFTA fresh beef imports

<table>
<thead>
<tr>
<th>Countries</th>
<th>Beef quota limit, mil. kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>No limit</td>
</tr>
<tr>
<td>Mexico</td>
<td>No limit</td>
</tr>
<tr>
<td>Australia</td>
<td>378.2</td>
</tr>
<tr>
<td>New Zealand</td>
<td>213.4</td>
</tr>
<tr>
<td>Japan</td>
<td>0.2</td>
</tr>
<tr>
<td>Argentina</td>
<td>20.0</td>
</tr>
<tr>
<td>Uruguay</td>
<td>20.0</td>
</tr>
<tr>
<td>Other countries or areas</td>
<td>64.8</td>
</tr>
</tbody>
</table>

Source: USITC Harmonized Tariff Schedule of the U.S. (2011)
Insights

• About 10% of U.S. beef production is exported and a similar percentage of U.S. beef consumption is imported

• Two major beef exporters from South America are Brazil and Argentina, but there are no fresh beef imports from these countries into the U.S. because of FMD concerns

• Recent regulatory assessments on South American beef could lead to regulatory changes that allow limited entry of beef from Brazil and Argentina

• Because of prohibitive TRQs, a beef import surge from Brazil and/or Argentina is unlikely

• We have developed a proto-type model that can be adapted and utilized to evaluate the economic impacts of any changes proposed to U.S. import regulations for beef